IALD/LIRC GUIDELINES FOR SPECIFICATION INTEGRITY

INTERNATIONAL ASSOCIATION OF LIGHTING DESIGNERS

IALD

Harbin Opera House - Interior Lighting Design
Lighting Design by Beijing United Artists Lighting Design
Photography © Adam Mørk

“ GOOD LIGHTING DOESN’T JUST HAPPEN. IT’S DESIGNED.

PREFACE

The International Association of Lighting Designers (IALD) is the only global association of architectural lighting designers. Lighting designers are a tremendous resource for innovative, practical, and economically viable lighting solutions. They understand the role of lighting in architecture and interior design and rely on their extensive experience and knowledge of lighting equipment and systems to enhance and strengthen design.

A lighting designer creates a design—that is, a way of achieving the client’s lighting needs and desires for a given project. The finished project is the physical realization of the design. Specifications are the descriptions of products that are to be installed on a project. They are the means of communicating the design to those who will build it in addition to drawings and other documentation.

The IALD has partnered with its manufacturer auxiliary, the Lighting Industry Resource Council (LIRC) to prepare and present these materials. Throughout we address a perennial challenge in the process of creating the built environment: how to ensure that what is designed is what is built. The following checklists, tips, and references offer lighting designers of any experience levels methods and techniques to protect specification integrity. “Specification Integrity” refers to the importance of maintaining the lighting designer’s original specification throughout the process of establishing a final project budget, retaining contractors and suppliers, and completing construction. A strong specification will help ensure that the finished project realizes the original intent of the design. Whether designers need to review the basics or are seeking more depth in the topic, we recommend using the references linked throughout the guidelines as need dictates.

CONTENTS

PILOT EDITION

IALD/LIRC GUIDELINES FOR SPECIFICATION INTEGRITY

The International Association of Lighting Designers (IALD) and the Lighting Industry Resource Council (LIRC) are pleased to present the 2017 "Pilot Edition" of Guidelines for Specification Integrity. Last updated in 2009, the 2017 materials represent a new approach to addressing the classic challenges of creating and defending lighting specifications.

HOW TO USE THESE MATERIALS:

The materials are not intended to be read straight through! Instead, it is easy to find a topic of immediate concern to you and explore it at various levels:

- **Checklists:** some material is presented in the form of checklists, which are easy to print or cut out and modify for your use.
- **Links:** within checklists and elsewhere in the material, topics are often presented at a general level with links to additional resources and information embedded in the topic.
- **Background reading:** "The Business of Building the Built Environment" offers a look at the entire process of design/pricing/construction globally, with special emphasis on points in the process that may pose threats to lighting specifications.

HOW TO CONTRIBUTE TO IMPROVING THESE MATERIALS:

Do you have a unique approach to setting up a luminaire schedule that you'd like to share with colleagues? Have you encountered "value engineering" proposals that packaged as something else? Do you have a foolproof way of addressing late submittals by contractors?

The dedicated IALD/LIRC volunteers who have contributed to these materials know that what is here now is just a start: there are many variations of the fundamental topics addressed here, and there are many topics that may not yet be addressed. We invite all IALD members to help improve these materials by contributing additional information, ideas, and examples.

A "PILOT EDITION"? WHAT'S THAT?

As we receive suggestions and ideas for additions to the "Guidelines", the PDF will be updated on a regular basis. As updates and revisions are incorporated, IALD and LIRC members will be informed, and the most recently updated version will always be available online.

TO CONTRIBUTE:

Send content, questions, or suggestions to:
John Martin, IALD Public Policy Consultant
john@iald.org

SECTION I: CHECKLISTS: SPECIFICITY IN SPECIFICATIONS

A lighting specification is a clear description of products that are to be used in a particular location in a certain manner on a given project, including how they are going to be controlled. The specification eliminates ambiguity by describing equipment in as much detail as necessary to achieve the desired aesthetic, perform the intended function, and comply with the project's goals and constraints. A clear description, along with quantities and installation details shown in drawings, allows for budgeting and bidding the lighting equipment.

The process of moving from concept to construction documents is iterative, and specifications evolve from a preliminary to a final format during that process. These guidelines do not claim to describe or outline the design process, but rather are intended to help a designer ensure that the intended equipment ultimately gets installed on the project.

FOR ANY PROJECT, THERE ARE THREE GENERAL RULES FOR SPECIFIERS TO FOLLOW:

- Write each specification clearly, concisely and unambiguously.
- Coordinate fully with the entire design team and other stakeholders.
- Participate in every stage of the project whenever possible, from concept to completion, always with an eye to maintaining the integrity of the lighting design.

CHECKLIST 1: BASIS FOR DESIGN

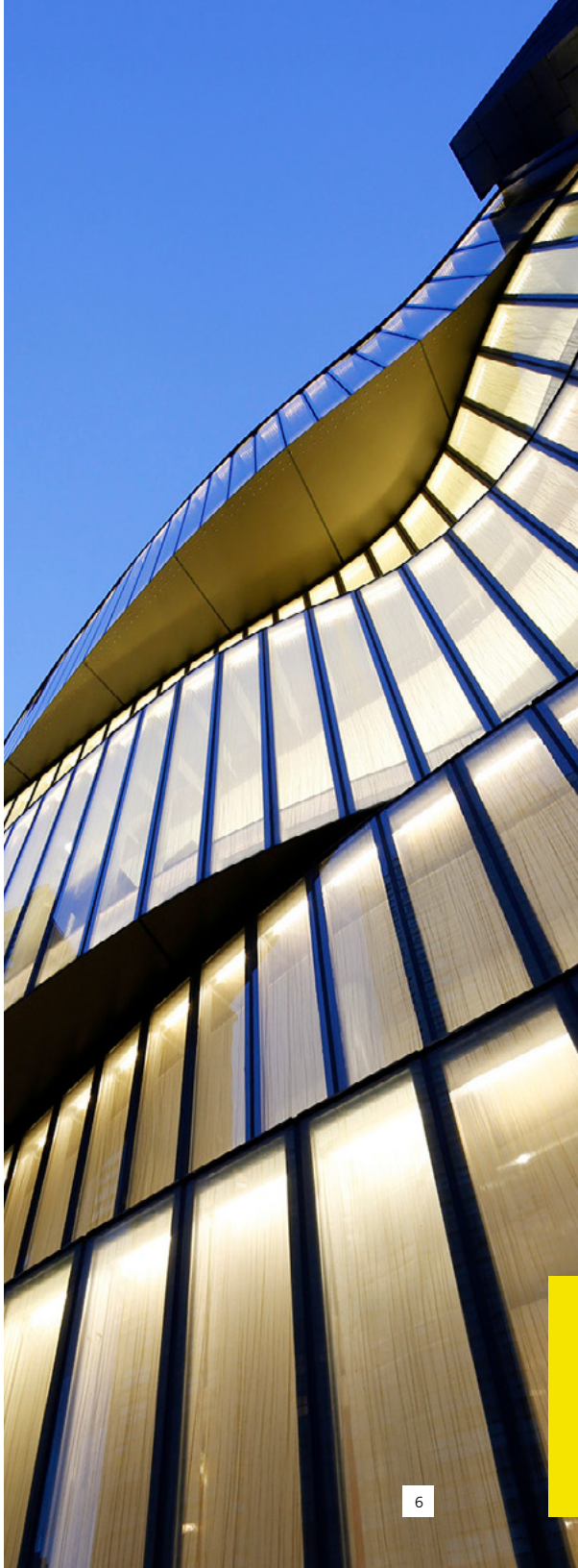
The following may be used to develop a "basis of design" at the beginning of a project. When used for that purpose, the decisions should be recorded for later reference.

ITEM	NOTES
Create Project Schedule (See NOTE 1)	
Create Budget (See NOTE 2) Manufacturer Pricing Is pricing guaranteed? Communicate to Client Calculate Return on Investment (ROI)	
Sustainable Design: Confirm energy codes and sustainability rating program (See NOTE 3)	
Review client specification standards (See NOTE 4)	
Determine unique products and substitutions and establish conditions (See NOTE 5)	
Determine phase structure of project bids and construction and any issues that may affect the structure	
Determine number of contractors	
Research regional lighting products	
Make contact with regional manufacturers and representatives	

CHECKLIST 2: DOES YOUR SPEC INCLUDE?

This checklist is simple and straightforward. Include all the content that is required in order to help ensure that the specification will be honored. From a business perspective, it is important for the lighting designer to be aware of the projected costs of defending specifications and include them in the client agreement.

ITEM	NOTES
What is the lighting designer's client agreement and scope of responsibility?	
Determine specification type (See Resource G)	
Generate Luminaire Schedule (See Resource B, and note that there are many variations on luminaire schedules)	
Generate Controls Schedule (See Resource C and Resource H)	
Use standard formatting (such as MasterFormat) (See Resource I)	
Determine what needs to be communicated to installers to ensure proper installation	
(If part of scope) Outline commissioning and additional services (See Resource J)	
Add unique items necessary for your project or practice	



Lincoln Square Synagogue, New York, NY USA
Lighting Design by Tillotson Design Associates
Architecture by Cetra Ruddy
Photography by © Emile Dubuisson

CHECKLIST 3: PROBLEMS AND WHEN THEY ARE LIKELY

Checklist #3 provides a project sequence of phases to outline actions the lighting designer may take at each in order to defend a specification. The listed phases are the same as used in Section III, "The Business of Building the Built Environment," and more detail about what happens in each phase may be found there.

Note that many steps listed here are not part of a specification or even steps for writing a spec. They are points within a project at which threats to specifications may occur, and steps lighting designers and their allies can take to protect specifications.

PHASE	POTENTIAL PROBLEM	COMMON SOLUTIONS AND MORE DETAILS	NOTES
1 **CONCEPT** **DESIGN** **BUDGET**	Unclear goals Client not on board Owner not on board Design-Budget Disconnect	See "Phase One Key Elements"	
2 **CONSTRUCTION DOCUMENTS** **BIDDING** **CONTRACTOR SELECTION**	"Value Engineering" (VE) "Packaging" Very low bids based on VE Misunderstanding of requirements	See referenced portion of section III—"Threats"	
3 **CONSTRUCTION** **INSPECTION** **COMMISSIONING** **OCCUPANCY**	"Substitution by Submittal" Substitutions for inadequate reasons Inaccurate claims related to product availability or lead time Failure to keep to necessary submittal/approval schedule Poor communication to notes/client, contractors, or other portions of material parties Post-installation problems	See referenced portion of section III—"Submittal Review" and after	

SECTION II: BEST PRACTICES TO SUPPORT SPECIFICATIONS

Establishing and demonstrating expertise in your field helps to ensure specification integrity by building up your credibility. The activities described in this section are designed to help lighting designers establish the knowledge bases that will help support specifications on any given project. That way it is clear to bidders and others that the specifications are based on a complete command of the field and not simply arbitrary selections.

It is vital to develop and maintain a knowledge base about lighting and controls products and product performance characteristics and pricing. This knowledge base will become a foundation for the specifications.

BUILD KNOWLEDGE ABOUT LIGHTING & CONTROLS PRODUCTS

1. Encourage manufacturers and their representatives to visit your office with working sample products rather than relying on catalogs or internet research. Use these visits to evaluate product performance.

2. Visit manufacturers' facilities to see how products are researched, developed, designed, manufactured, tested, and shipped.

   Consult manufacturers' websites for the most accurate information on their products and services. Manufacturers can also provide a portfolio of completed work.

3. Cultivate professional relationships at regional, national, and international levels with key factory-based contacts for manufacturers. Rely on these contacts for assistance when special requirements arise on projects.

4. Attend seminars and trade shows to evaluate lighting equipment performance characteristics, compare products, and remain current on new technology.

5. Obtain product samples of similar lighting products from multiple manufacturers for comparative evaluation.

   Record assessments of the products' qualities as part of your luminaire product database.

6. Develop standard notes relating to lighting products which are to be used for quality assurance during the project design process.

7. Refer to Resource D for a primer on what to look out for and what parameters to consider including in specifications.

Harbin Opera House - Interior Lighting Design, Harbin, China
Lighting Design By Beijing United Artists Lighting Design
Photography © Hufton+Crow

ESTABLISH CLEAR AND DEFENSIBLE STANDARDS OF QUALITY FOR LIGHTING EQUIPMENT

On an ongoing basis, it is important to establish clear and defensible standards of quality and distinguish among different specification product grades such as residential grade, commercial grade, specification grade, or museum grade. Establishing and maintaining these standards and the parameters that define them will help support specifications. If bidders, manufacturers, and others know what is expected and the designer prefers this option they may be less likely to attempt to introduce lower quality substitute products on any given project.

To help clarify your standards develop and use a checklist of product performance evaluation criteria. You may also wish to expand this checklist to become a basis for a standard submittal review checklist to use in your practice.

As part of your communications plan take steps to educate clients so that they understand the need for and benefits of specified products. Table top demonstrations and mockups can be helpful. In addition, many reputable manufacturers can often provide a list of projects locally or in the region that may reference a helpful installation of the product.

DEVELOP A LIGHTING SPECIFICATION AND PRICING DATABASE

Develop a database for lighting equipment and pricing by establishing categories for the key lighting products that are specified, and classifying them according to location, source and function, or application (e.g., recessed LED downlights, exterior metal halide floodlights, and control systems). Include manufacturer and product number information.

Track project pricing information in this database, to develop a history of unit price information which will be beneficial in evaluating lighting budgets for future projects.

Update databases and products on a regular basis and stay abreast of manufacturer price and component changes.

PERFORMANCE AREA	YOUR GENERAL STANDARDS
Photometric and visual performance	
Aesthetics, craftsmanship, and finishes	
Construction materials and fabrication integrity	
Energy consumption labeling for energy code compliance	
Electrical characteristics (e.g., power factor and thermal management)	
Cost, delivery, and installation	
Manufacturer's warranty, long-term availability, and support	
Field service	

SECTION III: THE BUSINESS OF BUILDING THE BUILT ENVIRONMENT

Threats to lighting specifications may arise at any point in the project process. This section uses a general global framework for construction projects to highlight common threats to specification integrity and possible actions by the lighting designer.

Lighting design practices often work globally, therefore it is helpful to become familiar with the names commonly used for phases throughout the world. Resource E outlines the stages of the design/bid/construction process as they are labeled and subdivided in many countries.

The phases and steps outlined here are generalized and idealized, in the sense that in the real world the sequence and number of iterations of each vary with every project.

While the names of project design phases may vary from country to country, nearly all have the same defining elements. We refer to these phases as:

PHASE 1

concept
design
budget

PHASE 2

construction documents
bidding
contractor selection

PHASE 3

construction
inspection
commissioning
occupancy

The Farm Residence, Gerroa, NSW Australia
Lighting Design by Electrolight
Photography © Rohan Venn

1

CONCEPT
DESIGN
BUDGET

UNDERSTAND AND COMMUNICATE GOALS: Communicate with the client and design team to establish project design goals. Establishing a clear design direction with the team early in the design process will facilitate having the specified luminaires actually purchased for the project.

DEVELOP AND COMMUNICATE PRELIMINARY DESIGN: Complete necessary drawings, renderings, and specifications to provide client and design team a clear understanding of the design. Modify as necessary to meet client and design team needs.

DEVELOP AND COMMUNICATE PRELIMINARY DOCUMENTATION AND SPECIFICATIONS: Develop lighting specifications based on the design by selecting high-quality luminaires that best achieve the design intent. High-quality does not have to mean high cost. Look for luminaires and manufacturers that fit with the project budget. If necessary, request working samples to determine quality and craftsmanship and to ensure that the luminaires can perform as desired.

BUDGET: Based on accumulated data from similar projects, on information from manufacturers and their representatives, and any other sources, establish a materials budget for lighting equipment on the project.

CLIENT REVIEW: Review the design, specifications, and cost with the client to ensure that all project goals have been met. By meeting the design goals and having the client agree to the design and specifications for the project, it may become easier to minimize the number of substitutions that take place in later phases.

COMPLETE: Complete and finalize the specifications. Finalize the project specifications by including all agreed-upon luminaires. Include all relevant information such as sections and details that may be needed for additional Requests for Information (RFIs).

225 Park Avenue South, New York NY USA
Lighting Design by Anita Jorgensen Lighting Design
Photography © Naomi Castillo Photography

The area covered by the shaded rectangle below includes the steps of concept, preliminary design and design development. Participants in this stage of the process are generally the design team and the Client/Owner, unless the phases have been restructured by use of "design-build," or "negotiated contract" approaches.

	PHASE 1			PHASE 2				PHASE 3			
FRANCE	ESQ Esquisse *Schematic Design*	APS Avant Projet Sommaire *Preliminary Design*	APD Avant Projet Detaille *Detailed Design*	PRO/DCE: PEO Etude de Projet et Dossiers de Consultation des Entreprises and Plans D'Exécution *Construction Documentation*				VISA Visa par L'Architecte des Etudes D'Exécution Etablis par les Entreprises et Des Etudes de Synthèse la Maitrise D'Œuvre *Mobilization*	DET Direction de L'Exécution des Marches de Travaux *Construction Administration*	AOR Assistance Aux Operations De Réception *Final Inspections*	
GERMANY	HOAI Phase 2 Vorplanung *Concept Design*	HOAI Phase 3 Entwurfsplanung *Schematic Design*	HOAI Phase 4 Genehmigung-splanung *Design Development*	HOAI Phase 5+6 Ausfuhrungsplanung + Vorbereitung der Vergabe *Construction Documentation*			HOAI Phase 7 Mitwirkung bei der Vergabe *Tender*	HOAI Phase 8 Objektuberwachung *Construction Administration*		HOAI Phase 9 Objectbetreuung *Final Inspections*	
INDIA	Concept Design	Schematic Design	Detailed Design	Bid Phase *Tender*	Construction Documents			Site Coordination (Mock-up)		Final Inspections	
ITALY	Preliminary Design	Final Project		Construction Documents			Preparation of Tender Documents	Site Supervision		Approval of the Implemented Project	
NETHERLANDS	Stap 1 Ontwikkeling *Development*	Stap 2 Schetsvoorstel/ Programma van Eisen *Outline Proposal/Program Requirements*	Stap 3 VO Voor Ontwerp *Design*	Stap 4 DO Definitief Ontwerp *Final Design*	Stap 5 Bestek *Specifications and Conditions*	Stap 6 Aanbeste-ding *Contract*	Stap 7 Gunning *Tender*	Stap 8 Uitvoering *Execution*		Stap 9 Oplevering / Revisie / Nazorg *Delivery / Revision / Aftercare*	
TAIWAN	SD Schematic Design		DD Design Development	CD Construction Documents			Bid Phase *Tender*	Shop Drawing Review	CA Construction Administration	Final Inspections (Punch List)	
UNITED KINGDOM	Stage 2 Concept Design	Stage 3 Developed Design		Stage 4 Technical Design				Stage 5 Construction	Stage 6 Handover and Closeout	Stage 7 Use and Aftercare	
UNITED STATES OF AMERICA	SD Schematic Design	DD Design Development		CD Construction Documents			Bid Phase *Tender*	CA Construction Administration		Final Inspections (Punch List)	

2

CONSTRUCTION DOCUMENTS

BIDDING

CONTRACTOR SELECTION

At this phase, plans and specifications are finalized for bidding, expected costs are compiled—with varying degrees of accuracy—and the project is brought to the beginning of construction. Because budgets and bidding are a key part of Phase Two, this is the period during which all specifications, not just for lighting, are under assault. The assaults may take many forms, including "value engineering" (sometimes abbreviated as "VE"), which is a nice way of saying, "We think this less expensive product will achieve project goals as well as the originally specified product."

The two major steps of Phase Two are issuance of Construction Documents and Bidding/ Contract Award; within these major steps, there are several actions the lighting designer may take to help ensure that specifications are protected.

CONSTRUCTION DOCUMENTS:

FULL INFORMATION: The lighting specifier must make sure that all required information is part of the "Construction Documents," so that bidders will have complete knowledge of the specifications and quantities required for the project.

COMMUNICATE: Prior to bidding, communicate with all parties as necessary to answer questions, alert manufacturers and their representatives to the project, and clarify specifications as necessary. Make sure that everyone has all needed information.

DISPLAY AWARENESS: Also, make sure that everyone knows the specifier is aware of the reasonable price ranges for products. This helps to ensure that the project will obtain the best pricing and service available.

Hancher Auditorium, University of Iowa
Cline Bettridge Bernstein Lighting Design
Photography © Bill Adams

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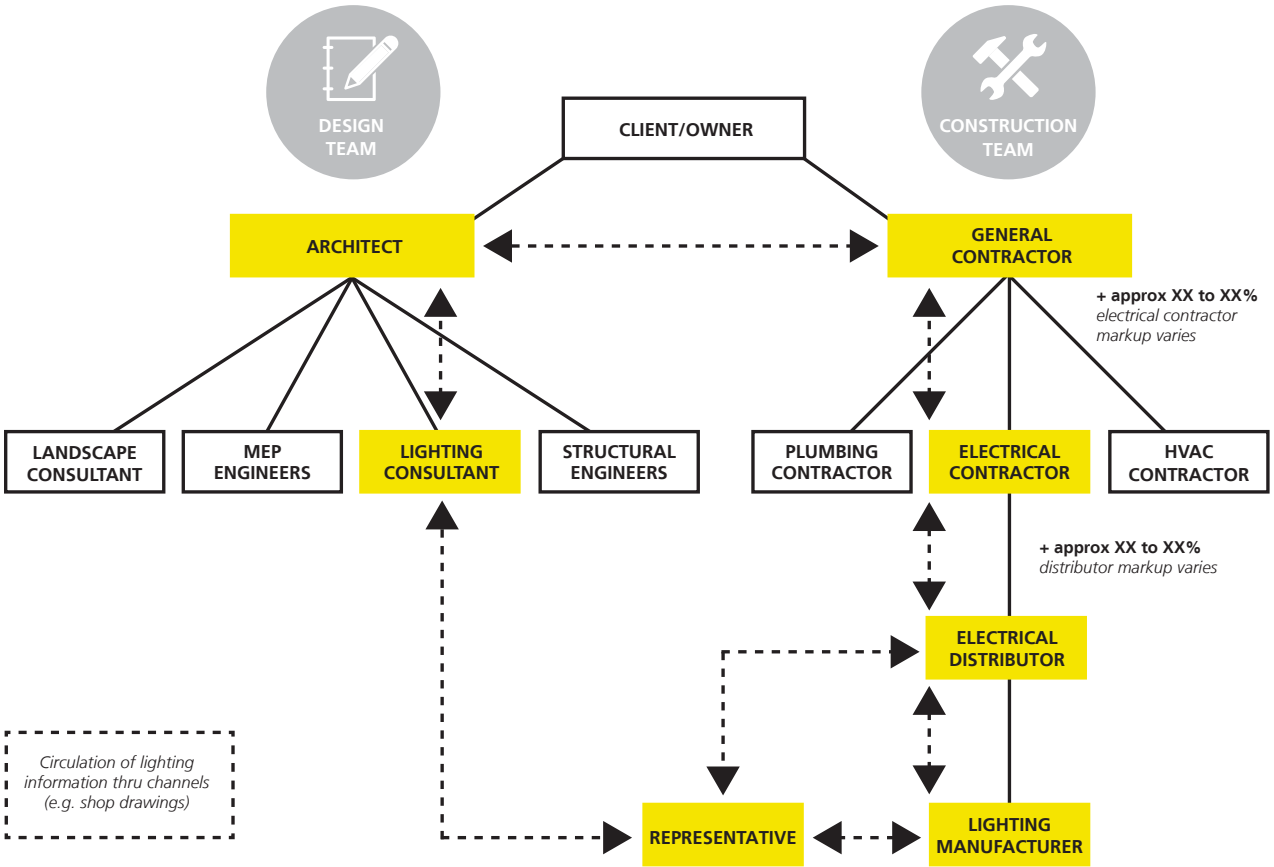
BIDDING/CONTRACT AWARD:

Phase Two brings additional participants to the project, mainly those involved in the construction process, including the product supply chain.

The diagram below, while typical of the United States version of information channels in the process, shows the complexities that may develop anywhere in the world:

NOTE:

Markups can vary based on specific vendors, geographic location, and other factors. Percentages indicated are only a guide.



Kyobashi Child Institution, Tokyo, Japan
Lighting M INC
Photography © Katsuhisa Kida, Fototeca Ltd

In the United States, lighting manufacturers typically sell their products through representatives and distributors who then provide products and services to an electrical contractor. Markups added to the manufacturer's price by the distributor, representative, and electrical contractor are customary and need to be carefully monitored. Markups can vary depending on which contractor is selected, the project type, the product type, the location of the project, among other factors. Among the complications and variations that may appear in this complex set of relationships are "packaging," a situation in which manufacturers' representatives and/or distributors offer discounts for substituting the specified product with another brand that they regularly carry.

THREATS TO SPECIFICATIONS

Threats to specifications are most likely to arise at the bidding/contract step of the project, because the financial status of the project is clarified at this stage. Specifiers should take the following steps at the bidding stage of any project:

WORK TO BE INVOLVED: Before and during the bidding/tender stage of the project, the lighting designer should make strong efforts to play a positive role in the review of bids and to be a helpful consultant in the decision-making process.

COUNSEL OWNER/CLIENT: Provide counsel to the Client/Owner regarding any lighting-related bid issues.

DESCRIBE IMPACTS: Discuss with the Client/Owner the possible impact of substitutions on project goals. Clarify in advance which products should not be substituted under any circumstance and why.

ADDRESS VE: Determine if "value engineering", or a similar project scope and cost review may be a factor on the project. Obtain a VE target number in writing to know when sufficient savings have been achieved. Clearly communicate, in writing, anticipated compromises in performance, operation or maintenance that may result from value engineering.

REVIEW BIDS: Insist that all bids include unit pricing on the base specs with add or deduct numbers for proposed substitutions.

SET CONDITIONS: Require the pre-qualification of any contractor-offered substitutions prior to the bid date. Require the contractor to submit on the manufacturer product he intends to furnish within fourteen (14) days of the bid. State specifically that failure to submit within the deadline constitutes a guarantee that only the base specified products will be supplied and that no other products, whether listed as alternates or not, will be considered.

SHOW PROJECT GOALS ARE ABOVE FIRST COST: Should the resulting construction bids require a reduction in project scope and cost, be in a position to advise upon the lighting portion of this effort by not allowing the contractor to influence design decisions exclusively through a cost-reduction focus.

888 Boylston, Boston, MA, USA
Buro Happold
Photography © Gabe Guilliams

3

CONSTRUCTION
INSPECTION
COMMISSIONING
OCCUPANCY

At last, construction is set to begin. All the participants are involved, real money is changing hands, and real contracts are signed. Even at this stage changes and challenges abound. To ensure design intent is realized, the lighting designer must review submittals from contractors, participate in construction administration, and make provisions for commissioning the project once construction is complete. These steps go beyond writing specifications, but are part of defending specifications and protecting a design. Of course, it is necessary to balance the need to protect a design against the basic business issue of what services the lighting designer is paid to provide!

Submittal Review

1. **ESTABLISH A PROCESS:** Establish procedures, in advance, for the review and the critical assessment of shop drawings, samples, and other submittal materials required from the contractor by the specifications. This assessment might include a shop drawing review log, etc. It is important to inform the Client/Owner of the procedures in order to receive the necessary information in a timely manner and to respond accordingly.

2. **STAY IN THE GAME:** Assist in the appraisal of samples, prototypes, or mock-ups that are required by the specifications. Inform the Client/Owner of any contractor responses that are inconsistent with the specifications or that may jeopardize the possible delivery time of the product.

3. **INSIST ON A SCHEDULE:** By delaying re-submittals of rejected products the contractor will sometimes try to gain acceptance because of time constraints. A time constraint for substitutions should be included in the base specs.

4. **USE A CHECKLIST:** Use a standard submittal review checklist to review the submittals with the final specification documentation. Add project specific notes to the checklist as each set of documents is reviewed and issued. The "Performance Characteristics" checklist in section II, "Best Practices," could be the basis for a standard submittal review checklist.

Construction, Punch List and Commissioning

Make site visits during construction as appropriate. Coordinate with contractors to ensure visits are both non-disruptive and useful to all parties. These steps are not technically part of writing specifications, but they are useful follow-through to help ensure that specified products are used in the way envisioned by the design.

1. **RESPOND TO QUESTIONS:** Respond to questions (Requests for Information - RFI) from the field in a timely manner so as to not jeopardize the project's schedule. Advise the team promptly if there is insufficient or incomplete information which is necessary in order to respond.

2. **MONITOR PROGRESS:** Stay in the communication loop to help monitor how well construction on the project is progressing, and flag any problems that may affect the lighting. This might include receiving copies of project reports, field reports, manufacturer delivery estimates, and similar information. It is important to digest the meaning of these data for the lighting design and report any impact to the client/owner in a timely fashion.

3. **PUNCH LIST:** A "punch list" is a list of corrections that need to be made to a finished project to bring it into line with the plans and specifications. It is good practice to work with the rest of the team to make sure that the lighting installation has been properly completed.

4. **COMMISSIONING:** This may involve anything from aiming lights and setting dimming levels to the final operational programming and testing of complex lighting control systems. Depending on the size of the project, be sure that specifications for control systems require adequate levels of support, including on-site work as necessary, from the manufacturer.

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CONCLUSION: MONEY, STRONG SPECIFICATIONS, AND COMMUNICATIONS

A lighting design is realized through the products that are specified, installed according to the plans, and operated according to the goals of the owner/occupant. Achieving the owner's and occupants' goals depends on realizing the design as accurately as possible. Realizing the design accurately depends on using the products specified and on how well the designer has communicated each and every aspect of the design.

In general, threats to specifications arise for financial reasons. In some form, one or more participants in the project believes a less expensive product will accomplish design intent as well as a product specified. These financial arguments can take many forms: budget constraints, Value Engineering, reductions through single-source "packaging", or contractor substitutions. Each of these amounts to an attempt to say that different products from those specified will accomplish project goals.

Defending specifications against such assaults is important. The best defense is to start with the best possible specification. The best possible specification is written clearly and concisely. It is based on a systematic approach to lighting challenges backed up by data and obvious experience. The best possible specification makes obvious that the produce specified is uniquely suited for the job at hand, and that any substitution will dilute the project.

Amanemu, Ise-Shima, Japan
Lighting Design by Lighting Planners Associates
Photography © Aman

RESOURCE A: GLOSSARY OF TERMS

BIM (Building Information Modeling): Building information modeling. BIM is a process involving the generation and management of digital representations of physical and functional characteristics of places.

CIBSE: The Chartered Institution of Building Services Engineers. Illumination standards of practice for the United Kingdom.

CONTRACTOR NET: The distributor's cost to the contractor prior to contractor markups.

CUL: Underwriter's Laboratory approved for use in Canada, and the United States.

DIN: "Deutsches Institut fuer Normung" (Germany Institute for Standardization) Guidelines.

DISTRIBUTOR NET: The manufacturer's cost to the distributor, prior to distributor markups.

IALD: International Association of Lighting Designers.

IESNA: Illuminating Engineering Society of North America.

IP RATING: International Protection code/rating. A two-digit rating system classifying luminaires according to their protection against the ingress of dust, solid foreign bodies, and water.

LEED: Leadership in Energy and Environmental Design. A voluntary, green building rating system, consensus-based national standard for developing high-performance, sustainable buildings developed by members of the U.S. Green Building Council www.usgbc.org

LIGHTING DESIGNER (LD) OR LIGHTING CONSULTANT: A trained professional with expertise in preparing documentation for lighting and lighting specification.

LIGHTING FIXTURE SCHEDULE (OR TABLE): An abbreviated summary of lighting products and/or lighting equipment specified for a project with product ordering information identified.

LIRC: Lighting Industry Resource Council.

MANUFACTURER: A fabricator of lighting equipment or control systems, their agents and/or representatives.

QUANTITY SURVEYOR (QS): Cost Estimator.

TENDER: Bid Phase.

UL: Underwriter's Laboratory.

VALUE ENGINEERING: A process of re-evaluating the project design to make cost savings to bring the project into the allocated budget.

RESOURCE B: SAMPLE LUMINAIRE SCHEDULE

The question of how much data to put in the luminaire schedule and where else that data can be found has varied answers around the world. The schedule in Resource B can link to additional product data held by the manufacturer or others. In the United Kingdom, the Chartered Institution of Building Services Engineers (CIBSE) has developed an extensive descriptive spreadsheet that can be used for a fixture schedule or as input for a BIM (Building Information Modeling) file. That template can be accessed here.

Germany and some other European countries rely on parameters outlined by the German electrical industry society ZVEI: "The following have been identified as major parameters:

1. rated input power
2. rated luminous flux
3. luminaire efficacy
4. luminous intensity distribution
5. colour quality
    a. correlated colour temperature
    b. colour rendering index
    c. colour tolerance
6. rated ambient temperature
7. longevity criteria (useful life of the LED luminaire in hours and the associated rated lumen maintenance)

Without the disclosure of these data (established in compliance with the IEC performance standards), it is not possible to perform a technical comparison of luminaires based on objective criteria.

No matter what format you use for a luminaire schedule, your specifications should include detailed descriptions and supporting documentation to ensure proper and complete sourcing and installation of lighting equipment. Information may include, but is not limited to:

- specification data sheets (sometimes called "cut-sheets")
- written descriptions
- manufacturers' catalogue or identification numbers
- any other information necessary to providing a precise description of the specified item

Note any accessories, special finishes, atypical mounting devices, and other unusual requirements for each luminaire type

For custom or modified luminaires, work with the manufacturer to receive a product reference designation that they can easily identify and price the custom or special luminaire. This will help to avoid confusion later on.

Make sure notes relating to a specific lighting product are shown only in one location to minimize errors if, and when, changes are made to the documents. Properly note and cross-reference schematics to aid contractors and other plan readers in identification.

The goal is clear, concise, unambiguous communication of the products required.

LUMINAIRE SCHEDULE

TYPE	LUMINAIRE		SOURCE TYPE	DESCRIPTION	MOUNTING	MANUFACTURER	CATALOG NUMBER	CONTROL PROTOCOL	ALTERNATES
	WATTS	VOLTS							

RESOURCE C: SAMPLE OF LIGHTING CONTROLS SEQUENCE OF OPERATIONS

LIGHTING CONTROLS SEQUENCE OF OPERATION

Date Revised: 12-Apr-2017
Project Name: Sample Project
Sequence By:

Space Type	Floor	Sequence:
Private Office	Floors 1-3	Sequence: ON: The lights are turned on through the use of the control on the wall. ADJUST: The user manually dims or selects On/OFF through the use of the preset scene control on the wall. OFF: 15 minutes after the room has been vacated, the lights will automatically turn off based on ceiling mounted sensor set to Vacancy. Integration with the Building Management System for measurement and verification is required.
Open Office	Floors 1-3	Sequence: ON: Lights automatically turn on at 6:00 AM. ADJUST: The user manually selects different pre-defined scenes through the use of the preset scene control on the wall. The lights continually adjust between off and a maximum level predetermined by the available daylight within the space. Average footcandle level is 30fc at 30" a.f.f. OFF: Lights automatically turn off at 8:00 PM. ADDITIONAL CONTROL: Integration with the Building Management System (i.e. BACnet) is included.
Conference Rooms	Floors 1-3	Sequence: ON: The lights are turned on through the use of the control on the wall. Shades are raised and lowered through the control on the wall. ADJUST: The user manually selects different pre-defined scenes through the use of the preset scene control on the wall. The lights continually adjust between off and a maximum level predetermined by the available daylight within the space. Average footcandle level is 30fc at 30" a.f.f. OFF: 15 minutes after the room has been vacated, the lights will automatically turn off. ADDITIONAL CONTROL: Integration with the Building Management System (i.e. BACnet) is included.
Dining and Cafeteria	Floor 1	Sequence: ON: Lights automatically turn on at 6:00 AM. ADJUST: The lights continually adjust between off and a maximum level predetermined by the available daylight within the space. Average footcandle level is 20fc at 30" a.f.f. OFF: Lights automatically turn off at 8:00 PM. ADDITIONAL CONTROL: Integration with the Building Management System (i.e. BACnet) is included.

RESOURCE D: TECHNOLOGY PRIMER

The purpose of this resource is to outline a few of the many issues which must be considered when choosing light sources for a project. It is critical to review the application, then examine the factors that are most relevant for that specific situation (e.g. lamp life, dimmability, light output, etc.).

1. ELECTRIC LIGHT SOURCES

1.1. Solid State Technology

1.1.1. Testing: LEDs must comply with all applicable testing requirements and conditions. For more information on individual standards, refer to the Lighting Guidelines and Standards chapter of this document.

1.1.2. Thermal Management: Consider the method of thermal management for solid state technology. For optimum performance, excess heat must be effectively drawn away from the diodes.

1.1.3. Circuit Board Ratings: Most LEDs rely on printed circuit boards (PCBs) as a part of the heat transfer function. A UL recognized PCB must meet strict performance requirements of the substrate and insulating material used provided that the electrical ratings and thermal limits are not exceeded under normal use.

1.1.4. Binning: The practice of binning is designed to maximize the effective utilization in the production of LEDs. The most critical bin criteria impacting product performance are light output, color consistency, and color temperature. LEDs are individually measured and sorted by lumen output into prescribed ranges. However, binning for color temperature is a more complex process.

1.1.5. Spares: It may be prudent to insert language in the specification for the manufacturer to provide a certain number of spare solid-state luminaires to the project to allow for variation in color from luminaire to luminaire, though this problem may be mitigated by specifying a source with a very small color tolerance.

1.2. Conventional Lamps

1.2.1. Lamp Life: Lamp life ranges from a few thousand hours to over 50,000 hours, depending on lamp type. Lamp life becomes important when factoring in accessibility, lifetime replacement costs, and maintenance costs.

1.2.2. Re-strike Time: For applications where luminaire starting time and re-strike time are critical, consider sources that have rapid-start capabilities, as well as little to no re-strike time. High-intensity discharge (HID) lamps, for instance, typically have a start-up and re-strike time, but halogen lamps do not.

1.2.3. Dimming: Each lamp type has various dimming capabilities and requirements; factor these into your specifications.

1.2.4. Light Level: Always evaluate the light levels required for a successful design in order to choose the correct lamp type for the application with regards to light output. Quick calculations can help to determine which lamp is ideal for the situation.

1.3. Color and Light Output

1.3.1. Color Quality: If color fidelity is an important aspect to the integrity of the design, it may be helpful to compare the capabilities of various light sources. For example, the high color rendering capabilities of halogen lamps may be desirable for museums, art display applications, or in hospitality settings. Look at working samples since color quality can vary from one product to another.

1.3.2. CRI: The Color Rendering Index (CRI) is a common metric used for describing how well a light source will display colors as compared to a black body radiator. CRI, as a metric, has known limitations, particularly for solid state sources.

1.3.3. TM-30-15: In the United States, the Illuminating Engineering Society (IES), in 2015 published standard TM-30-15 as an alternative and improvement to CRI. You may wish to discuss TM-30-15 and other newer color rendering approaches with manufacturers.

1.3.4. Color Consistency: The MacAdam Ellipse is a common way of defining color consistency. When color consistency is especially critical, noting the Standard Deviation of Color Match SDCM or 'MacAdam Ellipses' (i.e. a 4 SDCM = 4-step MacAdam Ellipse) can help to define the acceptable level of color consistency required for a project. The lower the number, the better the color consistency. CCT: Correlated Color Temperature (CCT) may also be used to provide a frame of reference for the design intent.

2. LUMINAIRE TECHNOLOGY

2.1. Luminaire Quality and Characteristics

2.1.1. Photometry trumps wattage: Lock desired photometry into specifications, rather than the luminaire wattage. As LEDs continue to improve, wattages may decrease. However, wattages are still important to note in the specifications for coordination purposes with the electrical engineer.

2.1.2. Delivered lumens: When comparing luminaires with varying light sources use delivered lumens as a metric rather than lamp- or LED lumens to account for optics, optical efficiency, thermal management, and other factors.

2.1.3. Luminaire 'Families': Specifiers may want to consider the same manufacturer for 'families' of products to minimize inter-luminaire color inconsistency, and/or to minimize the number of different luminaire manufacturers/LED chip types used in a given area of a project where possible to maintain a cohesive look.

2.1.4. Review Actual Samples: The evaluation of luminaires typically comes down to mechanical construction, workmanship and visual performance. Seeing a working luminaire in person is the best way to judge the quality level of the luminaire. Request working samples for in-house mock-ups, have a light meter on hand to check the light output, and compare the data to computer-

simulated lighting calculations. Often, local representatives can provide lists of installations or particular products in public spaces, or can help to set up tours with the factory.

2.2. Comparisons: A comparison between similar luminaires is often the most effective way to evaluate quality. Assess the luminaires by comparing characteristics such as:

- Light output
- Optical quality – beam distribution, beam quality and precision, doubling effects from the lens, etc.
- Dimming quality – visible flicker when luminaires are dimed, smooth dimming in the full range indicated on the manufacturer's data sheet, etc.
- Dimming protocol
- Construction and materials
- Manufacturer warranty on finish and workmanship
- Type of thermal management used by the luminaire; for example, does it employ individual heatsinks or are heatsinks part of the housing? (for LED luminaires)
- Type of optics used – reflectors, lenses, collimator lenses with secondary optic.
- Availability of independent testing data; do IES files and reports represent the luminaire that is desired?
- For LED luminaires, the LED die's manufacturer and the use of different diode manufacturers used for different luminaires within the manufacturer's product line
- Maintenance and replacement

2.3. Sources: Inquire which components are made by the manufacturer and which are sourced from others to give an indication of who controls the ultimate quality and availability of the product at the time of procurement and to gauge manufacturers' areas of expertise and where customization may be possible.

2.3.1. Analyze the method of phosphor conversion in relation to the application (e.g., a luminaire with a remote phosphor is not ideal for an application that needs to throw light over long distances because it would be less efficient).

2.3.2. Polar diagrams and electronic photometric files are also useful tools to aid in evaluating luminaire performance.

2.4. Performance Considerations

2.4.1. Thermal issues: Consider ambient temperature in any given application. Where appropriate, such as for exterior applications, consider thermal shock testing and full luminaire system thermal testing. For solid-state luminaire products, note that heat can affect issues from lifetime to color stability.

2.4.2. Humidity and Corrosion: Conformal coatings are applied to electronics to protect against damage or failure from dust, moisture, and other corrosive elements. This protection is an important aspect of any specification involving electronic components, specifically LED solid state technology, but it can also apply to ballasts, transformers, and other devices. A selective application of conformal coatings can be utilized to reduce costs where complete encapsulation is not required.

2.4.3. Emergency Lighting issues: Consider if this luminaire type will be providing egress illumination during power outage and emergency scenarios. Coordinate with the Engineer to ensure life safety code can be met.

3. LIGHTING CONTROLS

3.1. Interface: Control systems should have a user-friendly interface that meets the needs of both the users, as well as the maintenance staff.

3.2. Dimming: Always take into consideration the minimum dimming level required for the application in order to have a successful installation. Drivers may cause flicker if dimmed below a certain light output level. Mockups are recommended to test the system for compatibility.

3.3. Compatibility: Drivers and other components must be compatible with the building control system to achieve optimum results. Work with manufacturers and others to make sure that all control system components are compatible with one another and with any Building Management System (BMS) components involved.

3.4. Integration: Dimmable and multi-level drivers are also commonly available, which allows for easier integration with daylight harvesting, scheduling, and occupancy sensing.

3.5. Sensors: Vacancy, Occupancy Daylight, Dual-Tech, PIR, US . . .

3.6. Wiring requirements: line voltage, low voltage, RF, Bluetooth, Mesh

4. BALLAST AND DRIVER ISSUES

4.1. For cold weather applications, magnetic ballasts may be the better option, despite their tendency to have an audible sound.

4.2. When selecting a ballast, always confirm the system compatibility between the luminaire, ballast, and control system.

4.3. Drivers are often coded (programmed) for specific operational conditions, and using the wrong settings may destroy the LEDs very quickly.

4.4. Drivers must be incorporated into EMC (electro-magnetic compatibility) and RFI (radio frequency interference) tests to ensure system quality.

4.5. Some systems may provide an offering of constant light output, or constant flux, where the driver current slowly increases over time, providing a constant light level to the building. It is critical to coordinate with the electrical engineer to ensure that the building can handle the increase in current over the lifetime of the luminaire.

5. FLICKER

Flicker can be a problem in many environments. Test for flicker and make sure that the level of flicker from any light source is compatible with the proposed use of the space and will not have an adverse impact on occupants.

6. “GENERATIONAL” ISSUES

As technology changes, it is possible that the performance characteristics of particular products will change even when catalogue numbers and descriptions do not change. To bridge this generation gap, consider the following steps..

4.6. Where appropriate and possible, specify luminaires that are built on a modular system, allowing for the modules inside the luminaire to be replaced with more efficient types and enhanced glare control without changing the entire luminaire. This method enables the product to advance with time while still preserving its overall appearance.

4.7. Lock in the desired lumen output and wattage to help hold the integrity of the design and the required light levels. This tightening of the specifications becomes important since the lighting design and specifications may be complete years before the project is constructed.

4.8. Manufacturers must be able to ensure that the luminaires will remain on the market for the duration of a project, since visual impact can be critical and the substitution of other luminaires may not be possible.

4.9. Further future-proofing: when writing specifications, inquire from manufacturers and representatives whether: a) a similar lumen package in the future will have a similar light emitting surface, b) whether thermal characteristics will change, and c) whether newer model drivers will have similar electrical characteristics to present model drivers.

7. BIM (Building Information Modeling) Issues

Building Information Modeling BIM offers the ability to directly integrate photometry within the project documentation giving a more accurate measurement of lighting performance and direct coordination with other disciplines. BIM is the collaborative process of creating a 3D building model with “intelligent” components, meaning that the different building systems within the model can “talk” to each other to coordinate.

- Design work on projects using BIM may take longer to complete than normal due to the increased level of detail.
- Value engineering exercises within BIM can become tricky, particularly if the lighting models do not have accurate manufacturer data attached to them. Include language within the specifications noting that the luminaire specifications take precedence over the luminaire data contained with the BIM model.

RESOURCE E: GLOBAL PROJECT PHASE TERMINOLOGY

DESIGN PHASES – TERMINOLOGY USED AROUND THE WORLD

The names of project design phases vary from country to country, but nearly all have the same defining elements. Below is a chart of terms and phrases used commonly by design communities in different regions of the globe.

	PHASE 1			PHASE 2				PHASE 3		
FRANCE	ESQ Esquisse *Schematic Design*	APS Avant Projet Sommaire *Preliminary Design*	APD Avant Projet Detaille *Detailed Design*	PRO/DCE: PEO Etude de Projet et Dossiers de Consultation des Entreprises and Plans D'Exécution *Construction Documentation*				VISA Visa par L'Architecte des Etudes D'Exécution Etablis par les Entreprises et Des Etudes de Synthèse la Maitrise D'Œuvre *Mobilization*	DET Direction de L'Exécution des Marches de Travaux *Construction Administration*	AOR Assistance Aux Operations De Réception *Final Inspections*
GERMANY	HOAI Phase 2 Vorplanung *Concept Design*	HOAI Phase 3 Entwurfsplanung *Schematic Design*	HOAI Phase 4 Genehmigung-splanung *Design Development*	HOAI Phase 5+6 Ausfuhrungsplanung + Vorbereitung der Vergabe *Construction Documentation*			HOAI Phase 7 Mitwirkung bei der Vergabe *Tender*	HOAI Phase 8 Objektuberwachung *Construction Administration*		HOAI Phase 9 Objectbetreuung *Final Inspections*
INDIA	Concept Design	Schematic Design	Detailed Design	Bid Phase *Tender*	Construction Documents			Site Coordination (Mock-up)		Final Inspections
ITALY	Preliminary Design	Final Project		Construction Documents			Preparation of Tender Documents	Site Supervision		Approval of the Implemented Project
NETHERLANDS	Stap 1 Ontwikkeling *Development*	Stap 2 Schetsvoorstel/ Programma van Eisen *Outline Proposal/Program Requirements*	Stap 3 VO Voor Ontwerp *Design*	Stap 4 DO Definitief Ontwerp *Final Design*	Stap 5 Bestek *Specifications and Conditions*	Stap 6 Aanbeste-ding *Contract*	Stap 7 Gunning *Tender*	Stap 8 Uitvoering *Execution*		Stap 9 Oplevering / Revisie / Nazorg *Delivery / Revision / Aftercare*
TAIWAN	SD Schematic Design		DD Design Development	CD Construction Documents			Bid Phase *Tender*	Shop Drawing Review	CA Construction Administration	Final Inspections (Punch List)
UNITED KINGDOM	Stage 2 Concept Design	Stage 3 Developed Design		Stage 4 Technical Design				Stage 5 Construction	Stage 6 Handover and Closeout	Stage 7 Use and Aftercare
UNITED STATES OF AMERICA	SD Schematic Design	DD Design Development		CD Construction Documents			Bid Phase *Tender*	CA Construction Administration		Final Inspections (Punch List)

RESOURCE F: GLOBAL GUIDELINES AND STANDARDS APPLICABLE TO LIGHTING

Many countries have organizations that publish extensive and specific guidelines and standards. It is important to verify the specific guidelines that are applicable in the region or country where the project is located. The following chart is a brief outline of some applicable standards; however, it is not a complete and exhaustive list.

- Include language in the specifications that requires manufacturers to fabricate according to all applicable codes & product ratings (e.g. UL, cUL, DIN, IP ratings, IK ratings, etc.) which may be required in the jurisdiction in which the project is located.
- Both the Illuminating Engineering Society and the European Standards Organizations have published several standards regarding testing for various aspects of luminaires and light sources. Below is a chart describing a few of the many standards that may be applicable.
- To ensure quality, specify luminaires that comply with all testing standards applicable to the country in which the project is located. Reputable manufacturers are typically well informed and can advise as to which of their luminaires comply with standards in different regions of the world.

Many projects may follow various standards such as the ones shown in the following chart. Note that this list is not exhaustive and different standards may apply.

- Dark Sky – For areas and applications where the reduction of light pollution and sky glow is important, the International Dark-Sky Association (IDA) has several guidelines for lighting practices. Many municipalities have adopted the Model Lighting Ordinance for guidelines on exterior lighting. For more information on the IDA, please visit their website: darksky.org
- Wildlife ordinances may have an impact on lighting design depending on the area of the project. Often, ordinances require that exterior illumination be a certain color, such as amber, with minimal skyward light or minimal to no illumination towards/facing the waterfront areas within a particular radius of protected zones. Wildlife ordinances will vary depending on area and local endangered species. Check the applicable codes for the area in which the project is located.

ORGANIZATION	STANDARD	DESCRIPTION
European Standard	EN 13032-1	Measurement and presentation of photometric data of lamps and luminaires: Measurement and file format
European Standard	EN 13032-2	Measurement and presentation of photometric data of lamps and luminaires: Presentation of data for indoor and outdoor work places
Illuminating Engineering Society	LM-79	Internationally recognized method for the electrical and photometric measurement of solid state lighting products
Illuminating Engineering Society	LM-80	Internationally recognized method for measuring lumen maintenance of LED light sources
Illuminating Engineering Society	TM-21	Method for projecting the long term lumen maintenance of LED light sources

ORGANIZATION	ABBREVIATION	ORIGIN	DESCRIPTION
American National Standards Institute	ANSI	United States	Private organization that develops consensus standards and guidelines for various fields, including lighting products
American Society of Heating, Refrigerating and Air Conditioning Engineers	ASHRAE	United States	Global, professional society focusing on building systems and energy efficiency, among other things, that writes and publishes standards and guidelines
Chartered Institution of Building Services Engineers	CIBSE	United Kingdom	Internationally recognized authority on building services engineering and sets standards and criteria for best practice
China Compulsory Certificate	CCC	China	Required safety mark for products imported or sold in China
Commission Internationale de l'Eclairage	CIE	France	Professional organization focusing on the exchange and standardization of information everything relating to light and lighting
Deutches Insitut für Normung	DIN	Germany	National organization for standardization covering most fields of technology, including lighting
European Committee for Electrotechnical Standardization	CENELEC	Europe	One of the three officially recognized European Standardization Organizations that produces standards for a variety of fields, including lighting
European Committee for Standardization	CEN	Europe	One of the three officially recognized European Standardization Organizations that brings together the National Standardization Bodies of 33 European countries
European Standards	EN	Europe	Standards covering a wide range of fields that are recognized in the majority of European countries
Guobiao Standards	GB	China	National standards issued by the Standardization Administration of China and the Chinese sections of ISO and IEC
Illuminating Engineering Society	IES	North America	Professional organization the develops internationally recognized standards, guidelines, technical memoranda, and more
International Electrotechnical Commission	IEC	Switzerland	International organization that publishes standards for all electrical, electronic, and related technologies
International Organization for Standardization	ISO	Switzerland	Internationally recognized, independent, non-governmental organization that develops voluntary international standards
Regulatory Compliance Mark	RCM	Australia	
Underwriters Laboratory	UL	North America	Independent and globally recognized safety and certification company that certifies products in various markets
Underwriters Laboratory of Canada	cUL	North America	Canadian counterpart of UL

ORGANIZATION	ABBREVIATION	ORIGIN	DESCRIPTION
Abu Dhabi Urban Planning Council	Pearl Rating System for Estidama	United Arab Emirates	System for promoting the development of sustainable buildings through inter-disciplinary integration (http://estidama.upc.gov.ae)
American Society of Heating, Refrigerating and Air Conditioning Engineers	ASHRAE 90.1	United States	Benchmark for commercial energy codes in the United States (www.ashrae.org)
BRE Global	BREEAM	United Kingdom and European Union	Internationally recognized environmental assessment method for buildings and communities (www.bre.co.uk)
Building Construction Authority	Green Mark Scheme	Singapore	Initiative to promote sustainability and raise environmental awareness (www.bca.gov.sg)
Business Environment Council	BEAM	Hong Kong	Initiative to overcome barriers in green construction by creating a locally relevant approach (www.bec.org.hk)
California Energy Commission	Title 24	California, United States	Standards within the state of California set to conserve electricity and energy in buildings (www.energy.ca.gov)
Chinese Ministry of Construction	Three Star	China	Rating system for the development of sustainable construction (www.mohurd.gov.cn)
Green Building Council Australia	Green Star	Australia	Mark of quality and comprehensive rating system for the design and construction of sustainable buildings (www.gbca.org.au)
Green Building Council of South Africa	Green Star SA	South Africa	Standards and benchmarks for green buildings based on the Australian system (www.gbcsa.org.za)
Green Building Initiative	Green Globes	United States	Rating system working to promote green building practices (www.thegbi.org)
Japan Sustainable Building Consortium	CASBEE	Japan	Assessment tool for rating the environmental performance of building and the built environment (www.ibec.or.jp/CASBEE/english)
United States Environmental Protection Agency	Energy Star	United States	Voluntary program helping businesses and individuals save money and protect the climate through energy efficiency (www.energystar.gov)
United States Green Building Council	LEED	United States	Internationally recognized green building certification program for all construction with varying levels of certification (www.usgbc.org)

RESOURCE G: TYPES OF SPECIFICATIONS

A. SINGLE-NAME SPECIFICATIONS (PROPRIETARY SPECIFICATIONS)

1. Purpose: Only one product is suitable for the application and/or no known equals exist.

2. List the one and only product by manufacturer name and specific catalog number.

3. Advise the Client/Owner and project team prior to the bid date that these particular products are set aside for this treatment because of their unique character

4. Indicate in the specification that submissions of anything other than the listed product(s) will not be considered.

5. Make it clear in the specification that accurate pricing for all single name products has been secured prior to bidding and that the information has been shared with the Client/Owner.

6. Require unit pricing for products which clearly indicates what the contractor is charging the Client/Owner for the equipment.

7. Prepare for the Client/Owner, in advance, a detailed list of all the technical, performance, and design features that warrant this product's special consideration.

B. MULTIPLE-NAME SPECIFICATIONS

1. Purpose: Several products are available that will meet the design, performance, and budgetary requirements of the project/application, which gives the selected manufacturers the opportunity to bid the job competitively.

i. Note: Multiple name specifications may not allow the project team to fully plan, budget, coordinate and detail the design since it is unknown which product will ultimately be provided to the project.

2. List products by manufacturer name and specific catalog number. Whenever possible, list a product with the ordering number to serve as the preferred choice and the benchmark of quality. In addition, list up to two (2) alternate choices with manufacturer's name only, unless specifically agreed otherwise.

3. No two products are truly equal as this would most likely have copyright and patent infringements. Products which are 'substantially similar' may be appropriate to list in a multiple name specification.

4. Avoid using "or equal" in the specification because such language is too vague. Instead use "or approved equal" or "accepted alternate per specification" in the specification. This keeps the specification open, but allows the designer to evaluate what may be submitted as an "equal."

5. It is important to inform the Client/Owner and the project team that there may be times when only one product will work in a specific application and that multiple names may not be possible for that product.

C. PERFORMANCE CRITERIA SPECIFICATIONS

1. Purpose: Special requirements for many government and some private sector projects dictate the use of a performance criteria specification without the listing of manufacturers or specific catalog numbers.

2. The performance specification attempts to identify, as completely as possible, both the quantifiable and qualitative aspects of a luminaires performance. Any product submitted for consideration must meet or exceed the performance characteristics set forth in this specification.

i. Note: In many cases, performance specifications generate the widest competition and the best pricing.

3. Clearly identify all aspects of luminaire performance that are important to the situation in which the product is applied.

4. Whenever possible, provide quantifiable performance measures in the specification so that the potential for interpretive disagreements are minimized.

5. If non-quantifiable, qualitative aspects of a luminaire's performance are critical (style, craftsmanship, etc.), provide examples of similar products or applications that can be cited later for comparison.

6. Insist that the burden of proof with regard to a submitted product's ability to meet a performance criteria specification be placed solely on the submitting entity. The guidelines for a submission are especially critical in a performance criteria specification.

7. It is not unusual to request specific, highly developed calculations from vendors/ manufacturers as a requirement for a product submittal under a performance specification. This approach will not only help ensure compliance with the design intent, but it will also discourage the submissions of sub-par product contenders.

D. CUSTOM FIXTURE SPECIFICATIONS (SPECIALS, MODIFICATIONS, ETC.)

1. Purpose: When an original luminaire design is developed to fulfill a specific application on a project.

2. Custom designs should include a reference that the manufacturer is required to fabricate according to all applicable standards (e.g., UL, CUL, CE, DIN, RCM, CCC, wet location and/or any other labels) which may be required within the jurisdiction in which the project is located. For additional information on standards, refer to the Lighting Guidelines and Standards, Resource F.

3. Provide sufficient details within the construction documents to permit the contractor to reasonably assess the requirements for assembly and installation.

4. If several manufacturers are identified as capable of producing a custom design, they should be mentioned by name with a predetermined product reference number/code. Provide contact names, telephone numbers, and e-mail addresses whenever possible.

5. The custom luminaire manufacturer must include in his/her bid a working prototype and/or mock-up for review as a part of the custom design and manufacturing process, if requested in the specification.

6. Accept absolutely no substitutions on custom designs. Decision-makers must understand the rationale for this policy prior to bidding.

7. Construct a separate 'deduct alternate' if budget may become an issue. This will keep the specifier more in control in case of "value engineering." Value Engineering (VE) procedures should be agreed upon in advance, such as a limited number of reviews with an agreed target lighting budget.

8. Custom designs should be fully worked out in the design phase, if possible, and finalized in the construction documentation phase at the latest. This sequencing allows manufacturers to provide product numbers and appropriate unit costs so that detailing can be worked out with the architect and the project team. Keep in mind that quantities have a significant impact on pricing for custom designs.

i. Note: Custom designs developed too late tend to get very expensive or simply value engineered and substituted with something off-the-shelf and undesirable.

9. Custom luminaire designs often require longer lead times than standard products.

E. ALLOWANCE SPECIFICATIONS

1. Purpose: When an actual product has not yet been selected or a specific design approved. It is often used in situations where the bidding climate is uncertain or unknown. Always include an allowance when the schedule is issued for bid if a luminaire has not been agreed upon with the Client/Owner or design team.

2. Include enough information in the specification to allow the contractor to accurately price installation, electrical, and special needs (weight, voltage, wattage, etc.).

3. Allowance should be a distributor net, plus "the distributor and contractor mark-ups."

4. Allowances can be effectively used in the early design phases of a project when designs are still fluid. However, later in the project, allowances can be easy targets of value engineering and should be avoided whenever possible.

RESOURCE H: CONTROLS SPECIFICATIONS

1. Lighting Controls must comply with Energy Standards and Codes in place at the project locale. Some requirements may be:

- Daylighting
- Occupancy/Vacancy Sensing
- Automatic Shut-off
- Personal Control
- Step-dimming

2. Lighting controls are the end-user's gateway to the lighting system and therefore should be intuitive from an operational perspective within the space.

3. Coordination between lighting control and Building Management System should be determined during the design phase.

- ModBuss or BACnet

4. If luminaires are to be dimmed, coordination between the control system and the luminaire's dimming protocol is required. Some dimming protocols require additional wiring and should be a consideration especially on renovation projects.

- 0-10v
- Forward Phase
- Reverse Phase
- DALI

5. The specifier should coordinate layout of sensors during the design phase.

- Placement for daylight sensors
- Placement for Occupancy/Vacancy Sensors

6. The specifier should coordinate type of Sensor.

- Open Loop or Closed loop Daylight Sensor
- Ultrasonic, Passive-Infrared or Dual Technology
- Wired or Wireless
    - Wired: Line voltage or low voltage
    - Wireless: Proprietary RF, Zigbee, or Bluetooth

7. A Sequence of operations should be developed to aid in the system startup and commissioning process. See sample in Resource C.

8. Specification should consider including requirements for the following depending on the complexity of the project:

- Prewire visit
- System Startup

RESOURCE I: FORMAT OF SPECIFICATIONS

MasterFormat contains a list of construction specification components which are numbered and labeled. These numbers are included in the specification documentation, generally in headers or footers, depending on the project-specific graphic standards.

MasterFormat is divided into 50 divisions, with lighting being listed under Division 26 – Electrical. Within this overall category, there are numerous sub-categories. A few of the important sub-categories are outlined below. For a full outline of the current revision of MasterFormat, please visit www.csinet.org

26 50 00 Lighting

26 51 00 Interior Lighting

26 56 00 Exterior Lighting

26 09 23 Lighting Control Devices

For the exact numbering of sub-categories, consult with the architect and project team. Consistent numbering is important as the lighting outline specification document becomes part of a larger document issued by the entire team and sectioned to correlate to each other. Therefore, the each section must be formatted for consistency.

It is important to maintain cohesion within the project-specific specification standards as dictated by the Client/Owner and/or architect. These standards often include the project title, project language, typefaces and font sizes, numbering and lettering, and select graphic elements such as consultant/project logos. Maintaining these standards helps to preserve the overall project consistency, minimizes conflicts, and exhibits a coordinated effort on behalf of the overall project team.

Each of the divisions contains any number of sections, which are subdivided into three parts, "general," "products," and "execution." These subdivisions are commonly referred to as the "outline specification."

Part 1 - General (e.g. Related sections, Submittals, Warranties, Quality assurance, etc.)

Part 2 - Products (e.g. Fabrication, Luminaires & components, Product performance, etc.)

Part 3 - Execution (e.g. Delivery, Installation, Aiming & adjustment)

RESOURCE J: COMMISSIONING SCOPE OF ACTIVITIES

EXAMPLE SCOPE STATEMENT FOR FOCUSSING AND COMMISSIONING OF THE LIGHTING INSTALLATION

Focussing and commissioning of the lighting system shall be carried out after the installation has been fully electrically tested and snagging completed. The space shall be clean and tidy, free from builders' equipment etc. with all objects, surfaces to be illuminated etc. installed and free from obstruction.

The Contractor shall focus all adjustable light fixtures under the direction and to the satisfaction of the Lighting Consultant. As far as possible this work shall be carried out during normal working hours, but where and as required, shall be carried out during the hours of darkness.

Required commissioning sessions for this project (as a minimum) are as follows;

One session for pre-commissioning – attendees to include Contractor, lighting control systems representative, at which the operation of all facets shall be checked to ensure that all equipment is working correctly, so that focussing and level setting can commence.

One session for aiming of all lighting, and setting of controls - attendees to include Lighting Consultant, Contractor, lighting control systems representative, – at the end of which all adjustable fittings are aimed and all lighting controls are set. This session should take place immediately before handover, when all protective floor coverings and scaffolding are removed and all furniture and FF&E items are in place.

One session for client review - attendees to include Client/Owner, Lighting Consultant, Contractor, lighting control systems representative – at which Client/Owner comments can be incorporated into the final scheme.

Provide all access equipment as necessary for carrying out the lighting commissioning works.

The Contractor shall allow for the attendance during all setting up work of the light control system undertaken by the Control System Manufacturer/Contractor trained personnel. The Contractor shall ensure that the control system has been fully commissioned by the Control System Manufacturer prior to this programming work.

Commissioning activities as above may need to be repeated and the Contractor shall allow for attendance, etc., for such repeat work as required by either the Lighting Consultant and/or the Client/Owner.

NOTE 1:

Selecting products that can be delivered within the project schedule is key to maintaining the specification on many projects. Working backwards, develop (in conjunction with the design and construction team) a schedule for delivery of products based on the schedule for project completion back to bid and award of the project.

Allow time for punch list, programming, focusing, commissioning, installation; manufacturing and shipping; submittal approval, submittal preparation, bid and award. Be aware of product lead times when developing the specifications.

1.1. Standard lead time for commodity lighting products is often 4-6 weeks.

1.2. Manufacturers may indicate certain product type as quick-ship in their marketing material.

1.3. Custom fixtures often have a lead time from 8-16 weeks, after approval. Long lead times should be noted in the schedule to ensure the design and construction team is aware and submittals can proceed appropriately.

Chicago Riverwalk, Chicago, IL USA
Lighting Design by Schuler Shook
Photography © christian philips photography

NOTE 2:

Budget is often the overarching issue. It is important to establish a project's budget with the Client/Owner during the early phases. Work with the Client/Owner to make sure they understand the impact of budget issues on a project's design goals. Try to assure that expectations are realistic based on the budget available.

Develop a lighting budget at the commencement of the project. Ideally, the budget will be based on preliminary design drawings and ideas, and will emerge from discussion among the owner, the architect and the lighting designer. sometimes one must design to a budget; in any case, it is important to adhere to the budget once it is set.

- Manufacturers should assist with providing accurate budget pricing and should be advised to provide a competitive price if they are to be considered for a project. Better pricing is typically obtained earlier in the project schedule, rather than later during Bid or Construction phases.
- Keeping the project or Client/Owner names confidential at certain stages of the project may be necessary to receive fair and accurate budget pricing quotes.
- "Distributor net" costs are the most informative because the actual product cost can be evaluated without markups. Be sure to note that distributor and contractor markups need to be included separately, and can vary based on vendor and geographical location. Note that it is unlikely one will ever obtain completely accurate cost information, as the contractor is the ultimate customer of the manufacturer, and the economic interests of all involved focus on protecting the contractor. See the diagram in Section II to realize the complexity of interests involved.
- Pricing should be guaranteed for the duration of a project. Be aware that the manufacturer may have price escalation clauses if material purchase dates are extended.
- Communicate cost information, on a confidential basis, with the Client/Owner and a project's leaders, as required. Always advise clients that final pricing will differ from final pricing due to contractors' and others' mark-ups.

Return on Investment ROI: When writing specifications and comparing solid state technology with the other light sources, a cost analysis can be a useful tool to share with the Client/Owner. For example, while solid state technology and LEDs may have a higher initial cost, LED sources typically have considerably longer lives, as well as lower lifetime maintenance costs.

2.1. Early budgets may be based on an estimated cost per square foot (or meter). Later budgets should be based on pricing of the specifications at milestones in the design phases.

2.2. Budget pricing should provide unit costs rather than lump sums and should be for equipment only. Unit cost pricing allows the specifier to track changes more accurately. Other cost factors, such as lamps (where applicable), installation, delivery, taxes and miscellaneous electrical costs, if provided, should be listed as separate line items.

2.3. Factors that influence pricing include:

2.3.1. Project type and location:

2.3.2. Quantity of each fixture type

2.3.3. Product order information

2.3.4. Customization or modifications

2.3.5. Unique products, or single-name specifications

2.3.6. Budget pricing versus final pricing

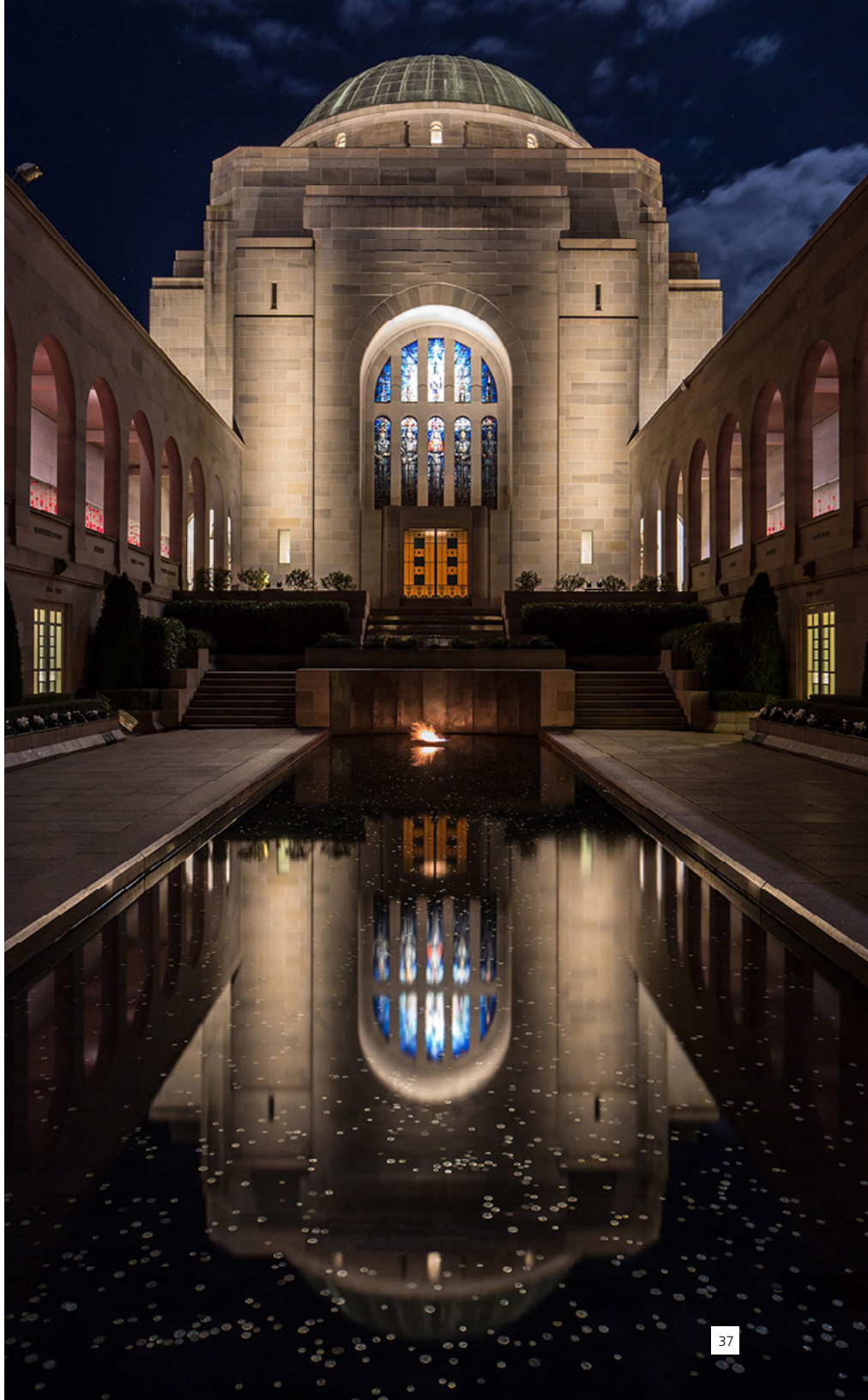
2.3.7. Exchange rates

2.3.8. Lamps (when applicable)

2.3.9. Taxes, delivery, miscellaneous electrical costs, and installation

NOTE 3:

3.1. Sometimes there are options for which energy code compliance path will be selected for the project. Know the codes well enough to be able to guide the decision to the code that provides the most flexibility for the project type.Project goals to comply with a sustainability rating system (e.g., LEED) should be determined as early as contract negotiations. See Resource E, "Global Standards Applicable to Lighting) for examples from around the globe.



Australian War Memorial, Canberra, Australia
Lighting Design by Steensen Varming
Photography © Rohan Venn

NOTE 4:

The client may have specification standards that apply to the project. If the project brief does not include creating new standards, the specifier may be asked to use the existing standards or defend decisions to deviate.

4.1 Examples of types of clients and reasons they develop spec standards:

4.1.1 A multi-building entity such as a college or medical campus. A centralized facilities maintenance group may develop standards to control variety and spares required.

4.1.2 Corporations with offices in multiple cities may want to assure consistency from office to office.

4.1.3 Retail/hospitality chains often develop standards as part of corporate branding.

4.1.4 Government entities, at any level, may require use of pre-approved fixtures.

4.1.5 Relationships are at the core of our industry. Good and bad experiences tend to affect future specifications.

4.2 Some examples of the types of standards:

4.2.1 Illumination levels and distribution: Clients may have requirements for illumination levels that address minimums, maximums, uniformity, and/or light distribution (spill light). These requirements may not align with recognized lighting authority recommendations and may have been developed without regard to energy code limitations.

4.2.2 Light source: An existing standard may have been written prior to the development of solid state lighting appropriate for the project at hand. When a standard includes legacy sources, reconfirm these requirements. More projects are insisting on a high percentage of solid-state lighting.

4.2.3 Color temperature: Color temperature of the light source may be based on preference, industry research or local ordinance. It may be desirable to encourage the client to consider color temperature based on materials to be used.

4.2.4 Color quality: Color quality for legacy light sources was usually addressed in general terms. Specifying the color quality for solid-state lighting is a more complex issue, with the development of new metrics to use in the assessment. Some projects (such as health care facilities) have critical color quality requirements.

4.2.5 Fixture manufacturers: The client may have preferences for, or prejudices against, a fixture manufacturer. This may be a regional preference; see Geographical Considerations.

4.2.6 Control systems or protocol: Similar to fixtures, control system manufacturer or protocols may be included in standards. This may be based on a need for future flexibility or features available from a given manufacturer.

4.2.7 Rating system: The standard may require use of fixtures that have achieved a high grade in a third-party rating system.

NOTE 5:

5.1. Some project types (e.g., publicly funded) do not permit single-name specifications. It may be necessary to get special permission, in advance of releasing the specification for bid, to include such products.

5.1.1. Develop a specification structure that identifies these fixtures. Coordinate with the client/owner for how these fixtures will be purchased.

5.1.2. Educate yourself, your professional colleagues, and your clients' project leaders to the value of unique products along with the necessity to protect intellectual property.

5.1.3. Include language in the specification that addresses intellectual property and original designs. Develop a policy in upholding design copyrights and discouraging the consideration of "knock-offs."

5.1.4. This may apply to decorative products based on certain aesthetics or may be performance driven.

5.2. Where a multi-name specification is required, develop a policy for whether substitutions will be permitted and the process for reviewing same.

5.2.1. Require that companies offering substitutions provide a manufacturer project list and the length of time the manufacturer has been producing the product being offered for substitution.

5.2.2. Require the pre-qualification of any contractor offered substitutions prior to the bid date of a project. Require contractors to submit on the manufacturer product he intends to furnish within fourteen (14) days of the bid. State specifically that failure to submit within the deadline constitutes a guarantee that only the base specified products will be supplied and that no other products, whether listed as alternates or not, will be considered.

Barneys New York, New York NY USA
Lighting Design by Cooley Monato Studio
Photography © Scott Frances

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