Emerging Lighting Technologies

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Overview

- New Lighting Technologies
- AB970 and "The Crisis"
- New Title 24

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New Lighting Technology

- 2nd Generation T-8 lamps
- T-5 Lamps
- High Output (HO) T-5 Lamps
- Induction Lamps
- "Pulse Start" Metal Halide Lamps
- Dimming Ballasts

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"2nd Generation" T-8 Lamps

- Higher CRI
- Increased lamp life to 24,000 hours
- Higher light output to 3,100 lumens
- Better lumen maintenance
- Only available in 4 ft. lengths at this time
- Cost premium when compared to "standard" T-8 lamps

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Trade Names for 2nd Generation T-8s

- GE "Starcoat XL"
- Osram Sylvania "XP"
- Philips "High Vision"

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2nd Generation T-8 Lamp Features

- More light for same input wattage (100-200 more lumens per lamp)
  - Allows use of reduced light output electronic ballasts in many instances
  - Can facilitate more energy-efficient design
- Longer lamp life & better lumen maintenance:
  - Extends relamping maintenance cycle
  - Lowers long-term maintenance costs

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The New T-5 Lamps

T-5 Circular Lamps

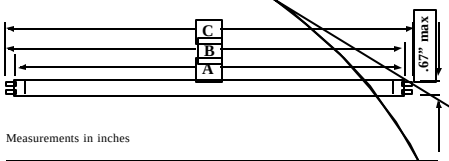
T5 Circular Lamp with T9 Circline

Lamp Efficacy vs. Diameter

Diameter	Watts	Lumens	Lumens/Watt
T5	28	2900	104
T8/800	32	3050	95
T5/HO	54	5000	93
T8/700	32	2850	89
T12/WM	34	2650	78
T12/CW	40	3050	66

Based upon nominal 4' lengths.

T-5 Dimensions



Measurements in inches

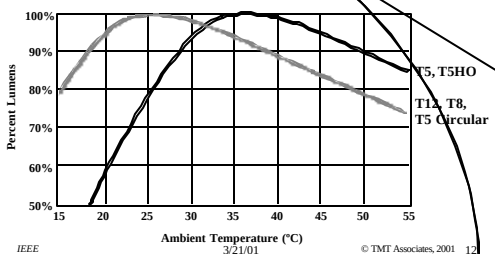
	A max.	B min.	B max.	C max.
F14T5, F24T5/HO	21.61"	21.8"	21.89"	22.17"
F21T5, F39T5/HO	33.42"	33.61"	33.70"	33.98"
F28T5, F54T5/HO	45.24"	45.42"	45.52"	45.8"
F35T5	57.05"	57.23"	57.33"	57.61"

T-5 Lamps - Performance

	2 Foot	3 Foot	4 Foot	5 Foot
Light Output (Lumens)	1350	2100	2900	3650
Lamp Power (Watts)	14	21	28	35
Lamp Efficacy (LPW)	96	100	104	104
Lamp Current (M. Amps)	170	170	170	170
Lamp Voltage (Volts)	82	123	167	209
Peak Output Occ. (°C)	35	35	35	35
Rated Avg. Life (Hours)	20,000	20,000	20,000	20,000

T-5 Peak Performance

Lumens vs. Ambient Temperature



T-5 Trade Names

- Osram Sylvania: "Pentron:"
  - Linear and HO
- Philips: "Silhouette"
  - Linear, HO, and circular configurations
- GE: "T5 Starcoat"
  - Linear and HO configurations

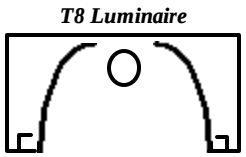
T-5 Vital Statistics

- Rated Life: 20,000 Hours
- Lengths: Nominal 2, 3, 4, and 5 ft.
- Colors: 3000, 3500 and 4100 K
- CRI: 85
- Std. Watts: 14, 21, 28 and 35 Watts
- HO Watts: HO 24, 39 and 54 Watts

T-5 Electronic Ballasts

- Slim profile: 1" x 1.18" x 13.26"
- 120 and 277 volt versions
- One and two-lamp models
- Programmed rapid start operation
- Dimming ballasts now available for both standard and HOT5 lamps

T-5 Luminaires



T-5 Applications

- Indirect suspended luminaire
- Direct/indirect lay-in luminaire
- Cove and valence lighting
- Wall washing
- Retrofit kits now available for existing recessed 2' x 4' lensed and parabolic troffers (use caution)

Additional Applications for HOT5s

- Indirect lighting with wider fixture spacings
  - Reduces initial costs for labor and materials
  - Reduces maintenance costs

Additional Applications for HOT5s

- Allows use of fluorescent in high bay applications (vs. HID)
  - Better color performance
  - No restrike / warm up delays
  - Longer life than most metal halide lamps
  - Better lumen maintenance
  - Much easier to use with energy-saving control strategies

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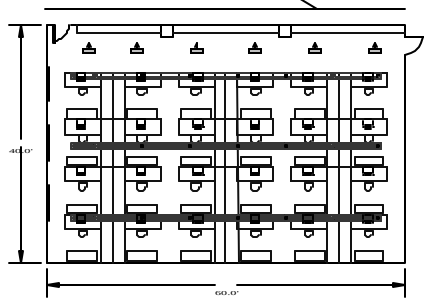
Example: "Typical" Indirect T-8 Layout



- 12' fixture spacing
- 24 two-lamp fixtures
- 2,820 watts
- 1.2 W/ft²
- 40-50 fc
- Excellent uniformity

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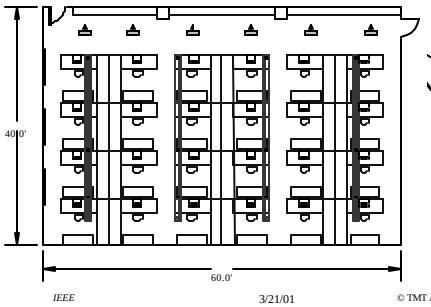
HOT5 Indirect Layout



- 15 ft spacing
- 16 one-lamp fixtures
- 1,992 watts
- 0.8 W/ft²
- 40-50 fc
- Excellent uniformity
- Reduced installation costs

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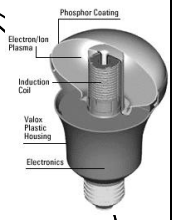
Induction Lamps

- How they work
- Features
- Products
- Applications

Induction Lamp Operation

- Electrodeless
  - No filaments to wear out
- Induction coil generates magnetic field within lamp
- Mercury vapor generates UV, converted to visible light by phosphor coating



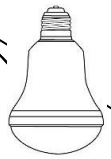
Induction Lamp Features

- Long lamp life
  - 15,000 hours for 23W R25 lamp
  - Up to 100,000 hours for larger lamps
- High CRI of 80+
- Variety of color temperatures

Induction Lamp Products

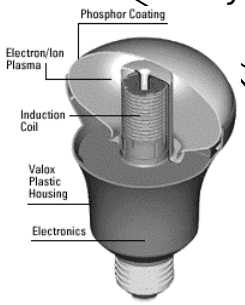
- GE "Genura"
- Philips "QL" Series
- Osram Sylvania "Icetron"

GE "Genura"



- 23W
- 1100 lumens
- 2700 K, 3000 K CCT
- R25 envelope
- No exterior generator
- Direct retrofit for R30 incandescent
- 15,000 hour lamp life

Genura Anatomy



Philips "QL" Series

- 55W, 85W, 165W
- 3,500, 6,000, 12,000 lumens
- 100,000 hour lamp life
- 2700 K, 3000 K, 4000 K CCT
- 70% lumen maintenance at 60,000 hours
- "G" type envelopes

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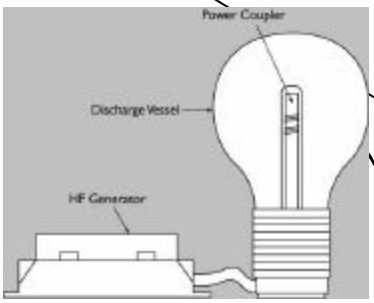
QL Lamp Anatomy



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Osram Sylvania "Icetron"

- 100W & 150W versions
- 8,000 & 12,000 lumens
- 100,000 hour lamp life
- 3500 K, 4100 K CCT
- Separate generator
- Elongated donut shape

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Induction Lamp Applications

Any situation where relamping is difficult, or where maintenance is a concern:

- High ceiling spaces
- Remote fixture locations
- Interior general lighting
- Warehouse lighting
- Other high bay applications
- Roadway lighting
- Parking lots
- Exterior pedestrian lighting
- Tunnel lighting
- Recessed downlights (esp. Genura)

Pulse Start Metal Halide

- Characteristics
- Historical Considerations
- Benefits

Pulse Start Lamp Characteristics

- Lamp arc tube shape, fill material and starting method are dramatically different
  - More rugged arc tube construction is key to higher performance
- Lamp ignitor is typically separate
  - Similar to HPS lamp-ballast systems
- Previously was employed only in smaller lamps
- Now available in most typical lamp wattage configurations

Historical Considerations

- Metal halide lamps criticized for:
  - High lumen depreciation
  - Poor color temperature uniformity among different lamps
  - Color shift
  - "Cool" color appearance
  - Slow lamp starting and restrike time

Pulse Start Benefits

- Higher initial light output
- Up to 35% higher maintained lumens
- Longer Lamp Life
- Improved Color Performance:
  - Reduced color shift
  - Improved lamp to lamp color uniformity
- Faster start up and restrike
- Warmer color temperatures available

Dimming Ballasts

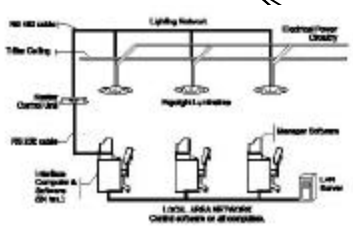
Dimming Ballasts - Availability

- Available for nearly all applicable lamp technologies
  - T-8 lamps
  - T-5 and HOT5 lamps
  - Compact fluorescent lamps
  - Metal halide lamps

Dimming Advantages

- Maximizes energy savings
- Maximizes visual comfort and visual performance
- Research suggests increased worker productivity
- Contributes to esthetics of the building space

Cutting Edge Lighting Technology



The California Energy Crisis

- AB 970
  - California Energy Security and Reliability Act of 2000
  - Signed into law by Governor Davis on September 6th, 2000
  - Emergency legislation designed to provide a balanced response to the state's electricity problems

AB 970

- Directed the California Energy Commission to adopt and implement cost-effective Standards
- Required action to occur within 120 days
- Disrupted the normal three-year Title 24 revision cycle

Effective Date

- The effective date of AB 970 Building Energy Efficiency Standards is June 1, 2001
- All buildings permitted on or after June 1 st have to comply with the new Standards

Potential Savings from AB 970

- 150 megawatts electrical demand
- 548 gWh electrical energy for 2001
- 134,777 MBtus natural gas for space heating and water heating

Changes to Title 24 Lighting Requirements

- Bi-level Switching Requirements
- Automatic Shutoff Requirements
- Minimum efficiency requirements for exterior lighting
- Lighting Power Allowances
- New means of calculating actual lighting power in office spaces

Changes to Bi-Level Switching Requirements

- Old Title 24: spaces with LPD <1.0 watts/s.f. exempt
- New Title 24: spaces with LPD <0.8 watts/s.f are exempt
- Spaces with occupancy sensors are no longer exempt
- Spaces with automatic time switches are no longer exempt

Changes to Automatic Shut-Off Requirement

- Old Title 24: applicable only to buildings > 5,000 s.f
- New Title 24: applies to all buildings

New Requirement: Exterior Luminaires

- Applies to all permanently installed luminaires attached to or powered by electrical service in buildings containing conditioned space
- Exterior luminaires >100 watts must have minimum source efficacy of 60 lumens per watt
- Exception: luminaires controlled by motion sensors

Lighting Power Allowance

- Some minor changes to lpd allowances in both complete building and area category allowances

Calculating Lighting Power in Offices

- Calculation must now include portable task lights in addition to other lighting
- Includes lighting integral to modular furniture, portable freestanding lights, lights attached to workstation panels, etc.

Calculating Lighting Power in Offices

- If actual watts are not known at the time of permitting, one must include:
  - 0.2 watts/s.f. in office areas >250 s.f.
  - No additional wattage calculation required for office areas 250 s.f or less

Calculating Lighting Power in Offices

- The actual power for the portable lighting may be included if sufficient supporting evidence is submitted and accepted by the building department
  - Must be clearly indicated on the plans

PG&E Rebates for 2001

- Rebates available for many of the newer lighting technologies:
  - 2nd Generation T-8 lamps
  - T-5 Lamps
  - Induction Lamps
  - Metal Halide Lamps
  - Dimming Ballasts (when used w/photocells)

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