Lighting Technology Update

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"Good" Lighting

The Hallmarks of "Good" Lighting are:

- Aesthetically Pleasing
- Energy Efficient
- Adequate Task Light Level
- Visually Comfortable
- Easy to Maintain
- Enhance Productivity & Well-Being
- Minimal environmental impact

Today's Lighting Technology can do this!

"Yesteryear"

A room 25x30x12 feet in Central School, Glencoe, Ill., has an average intensity of twelve foot-candles provided by six 300-watt indirect units.

"Yesterday"

"Today"

Technologies

- Incandescent/Halogen
- Fluorescent Systems
- HID Systems
- Lighting Controls

Incandescent/Halogen

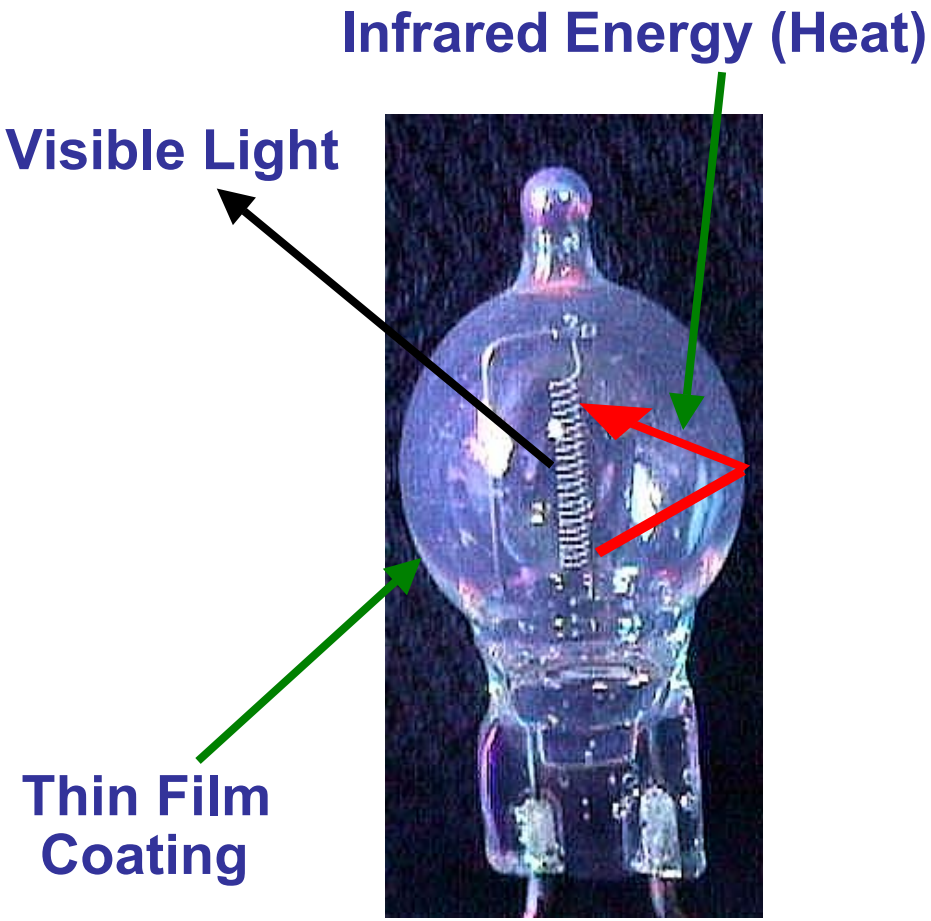
Principles of Operation

Incandescent

Halogen

IR Halogen

New Kid on the Block! IR Halogen Technology



- More visible light generated for each watt consumed
- Lower energy costs and less heat generated
- Multi-layered thin film Infrared coating on outer surface of halogen capsule
- Infrared energy (heat) is recycled within the IR capsule

Technologies

- Incandescent/Halogen
- **Fluorescent Systems**
- HID Systems
- Lighting Controls

Fluorescent Systems

The Lamps:

Linear Fluorescent

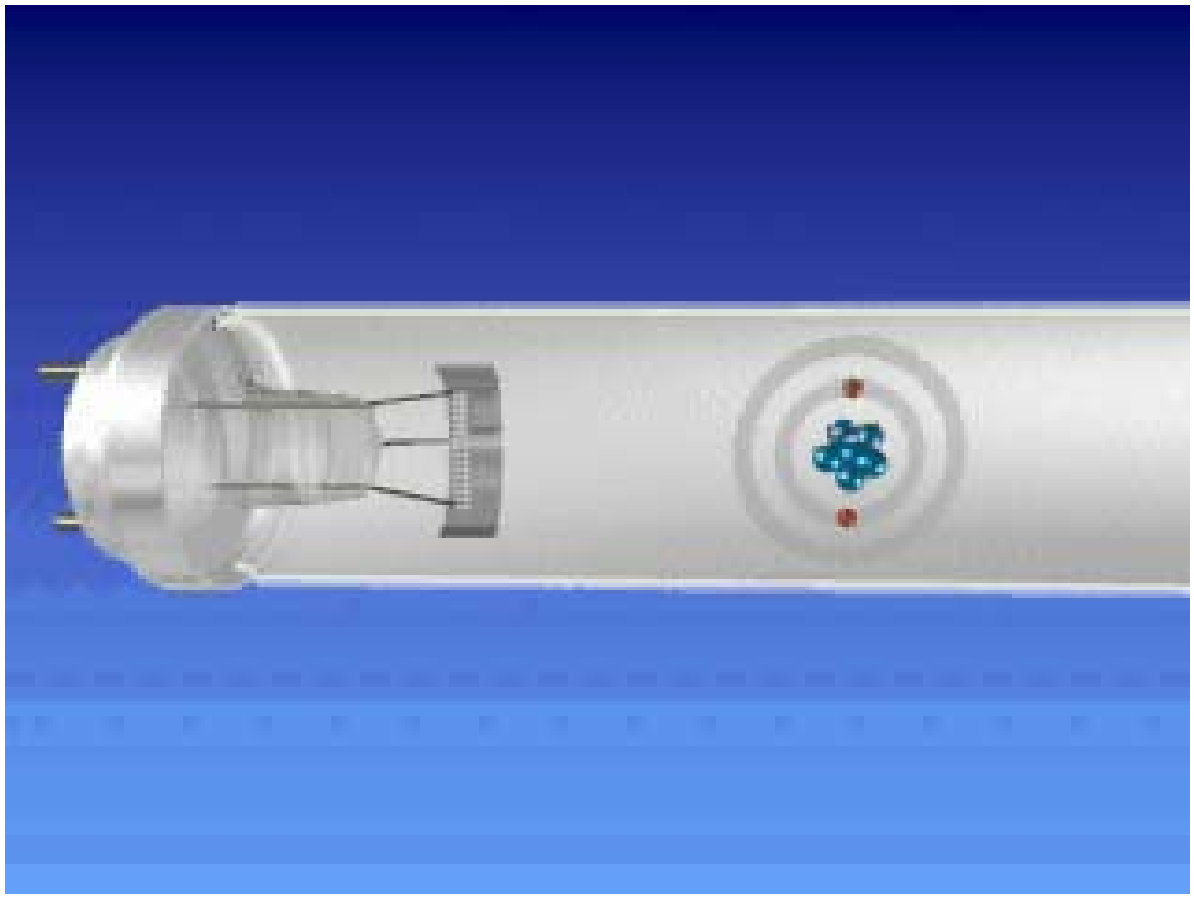
Compact Fluorescent

Fluorescent Systems

The Fluorescent System:

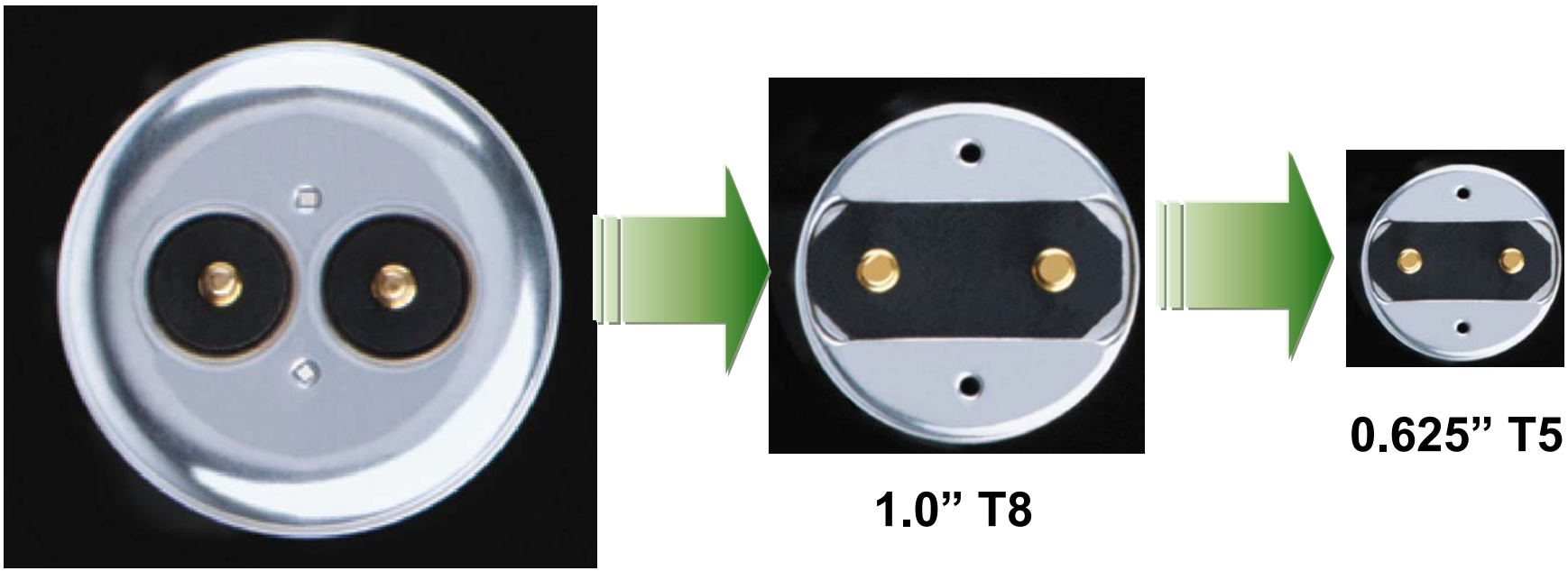
Fluorescent Systems

Principles of Lamp Operation:



Fluorescent Systems

Lamp technology has moved forward



1.5” T12

1.0” T8

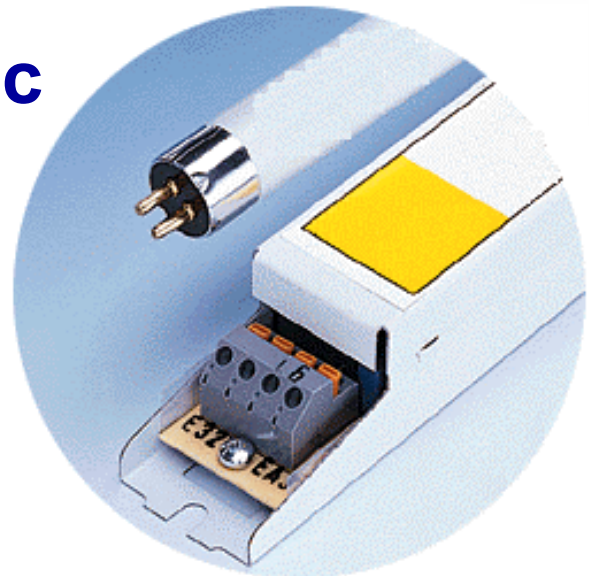
0.625” T5

Fluorescent Systems

Fluorescent Ballast Types

- **Magnetic**
  - **Standard**
  - **Energy Saving**

- **Electronic**



Fluorescent Systems

Electronic Ballasts

Advantages

- Multiple lamp operation
- Very energy efficient
- Lower operating cost
- Relatively lightweight (potted/unpotted)
- Quieter and cooler operation
- Special functions/features available
  - Lamp End of Life Sensing
  - Programmed Starting
  - Dimming
  - Status Reporting
  - Universal input voltage

Disadvantages

- Slightly higher per unit cost – lower per system cost

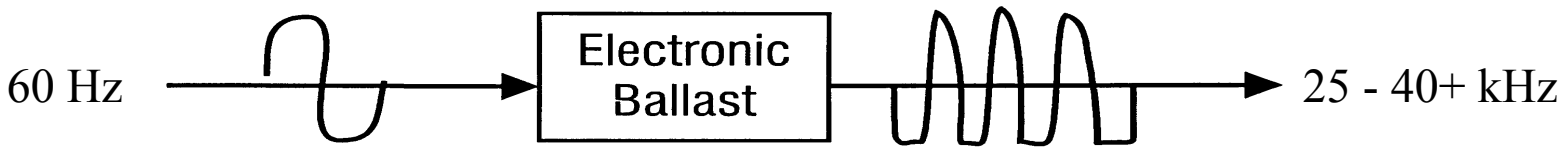
Magnetic Ballasts

Advantages

- Lower per unit cost

Disadvantages

- Higher operating cost compared to Electronic
- Relatively heavy compared to electronic
- 1 or 2 lamp operation only
- Series lamp operation
- Recycling Issues (PCBs in older units)



Fluorescent Systems

Preheat Fluorescent Ballasts

- Time delay to lamp start - flicker
- Cathodes are heated prior to lamp start (0.5-1.0s)
- Lamp start in 1.0 - 2.0 seconds
- 2 step process: Coil heat then OCV 0.7-2 kV applied
- External starter required

Rapid Start Fluorescent Ballasts

- Cathodes are heated constantly by applying coil voltage
- Series operated
- Ground plane required for starting
- Operation down to 50°F

Instant Start Fluorescent Ballasts

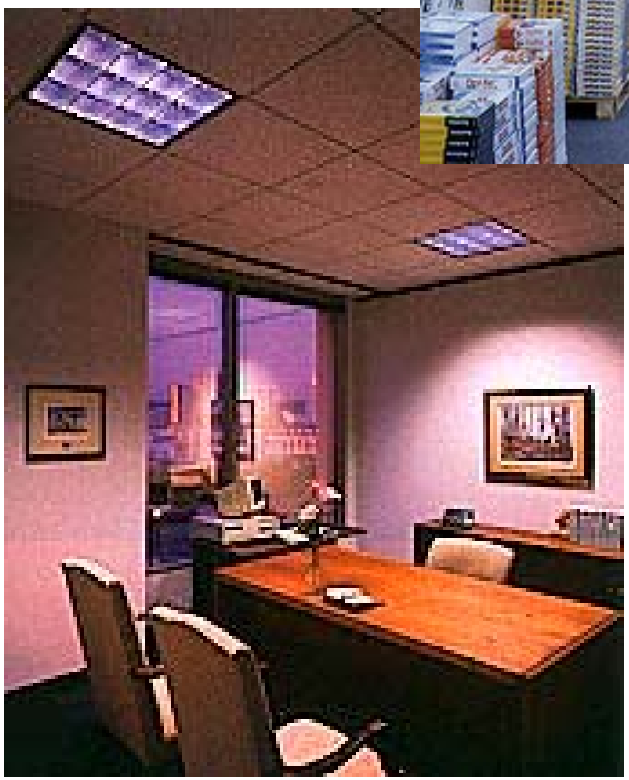
- Most energy efficient system- no cathode heating
- Discharge arc initiated by applying high OCV to jump start lamp
- Parallel operation
- Operation down to 0°F
- NEMA recommendation – shunted sockets for retrofit

Fluorescent Systems

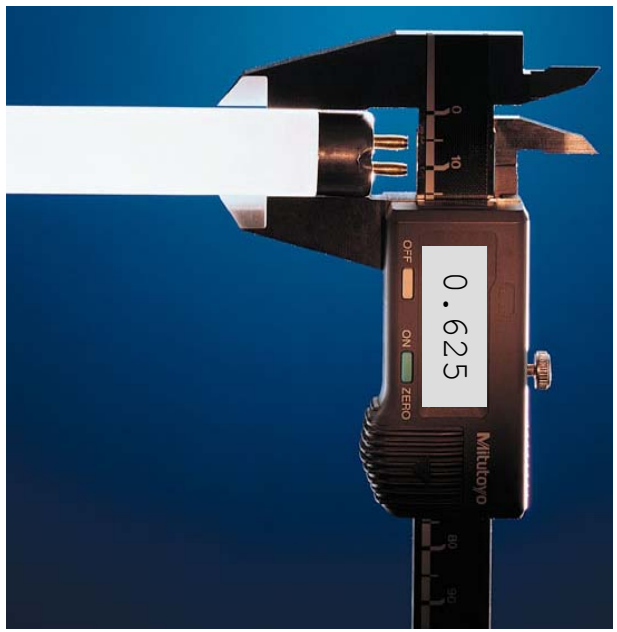
Programmed Rapid Start Fluorescent Ballasts

  - Coil heat applied w/reduced or no open circuit voltage (OCV)
  - OCV is then applied (After coils reach optimum temperature)
  - Typically 50,000 to 100,000 start cycles
  - Up to 250% longer life than current systems (IS/RS)
  - Coil heat turned off or reduced after lamp starts
- Lower energy consumption than rapid start
- Longest lamp life in all applications
  - Including high switching cycles – Occupancy Sensors
- <10% THD
- Multiple ballast factor options 0.71 – 1.20

Fluorescent Applications



T5 Systems



T5 vs. T8

T8 Applications
- Retrofitting T12 fixtures
- New direct fixtures

T5 / T5HO Applications
- New indirect fixtures
- Multi-lamp high bay fixtures
- Not really a retrofit

Fluorescent Applications

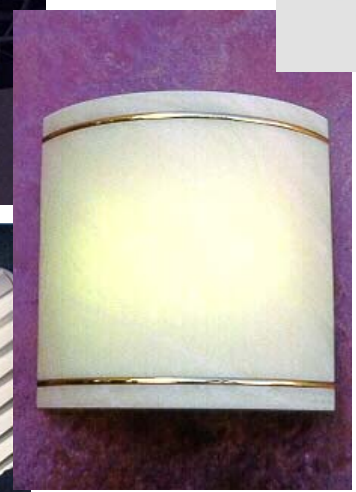
T5HO

Fluorescent Applications

T5HO – Indirect

CFL Systems

- Applications: downlights, wall washers, wall sconces, table lamps, floor lamps, pendants, low and high-bay industrial/sports lighting



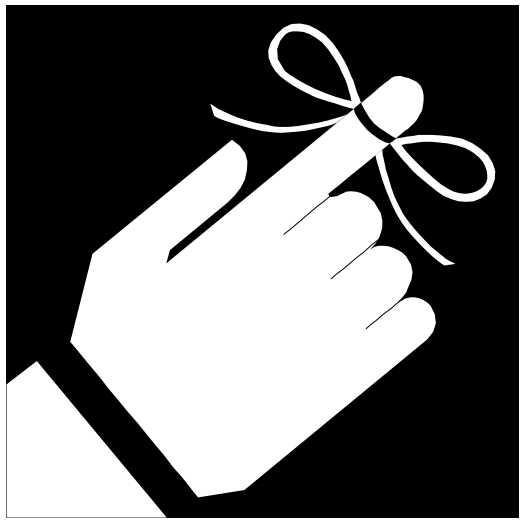
Technologies

- Incandescent/Halogen
- Fluorescent Systems
- Lighting Controls

Lighting Controls

General Rule of Thumb

- The installation of properly applied controls to a lighting system will reduce energy consumption by one third.



Lighting Controls

PURPOSE OF CONTROLS

- Enhance Building Environment
- Visual Comfort
- Lighting Quality
- Adaptability
- Conserve Energy
- Conserve Money
- Conserve Equipment

Lighting Controls

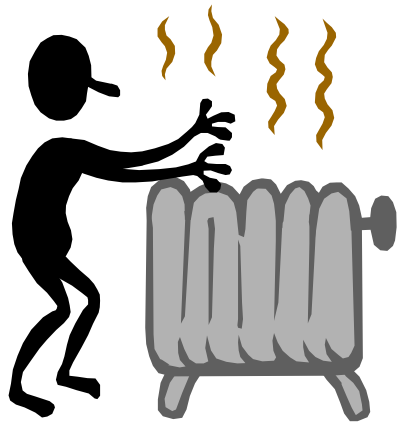
DIRECT BENEFIT OF CONTROLS

- Straight energy savings
- Maintenance savings
- System life extension
- Reduction in demand charges
- Cost savings on “Time of Use” energy rates

Lighting Controls

INDIRECT BENEFITS OF CONTROLS

- Impact on building HVAC system
  - for every 4-5 Watts of Light, 1 Watt heat



- Lower maintenance cost due to longer effective lamp life.

Lighting Controls

MAJOR STRATEGIES FOR LIGHTING CONTROL

- Time based
- Occupancy based
- Light level based

Can be mixed and matched for effectiveness

Lighting Controls

TIME BASED OR SCHEDULED CONTROLS

- Provides light to an area when scheduled for use
- Does not control amount of light
- Simple mechanical timer to central building systems
- Some lights must always remain on.
- Not suitable for areas with highly variable occupancy.

Lighting Controls

TIME BASED OR SCHEDULED CONTROLS

Energy Management Systems

- Can control lighting and other systems
- Trend is toward fully integrated systems
- Lighting, HVAC, Security and Accounting
- Maximizes occupant comfort if set up correctly.
- Gives total picture of energy use and control.

Lighting Controls

OCCUPANCY BASED CONTROL

Occupancy Sensors

- Regulate lighting system operation based on actual use
- Do not require scheduling
- Off delay time must be set with consideration to source used and application.

Occupancy Sensor Types

- Infrared - Direct Line of Sight
- Ultrasonic - Indirect, Spatial limits
- Microwave - Indirect, Similar to Ultrasonic
- Dual Technology - False Tripping
- Ceiling and Wall Mounted
- Line and Low Voltage

Lighting Controls

LIGHTING LEVEL BASED CONTROLS

- Vary light output of system to match desired target illuminance
- Provide only the quantity of light required
- Can compensate for lamp/fixture depreciation
- Two methods of control
  - Selective switching (banks of lights or stepped dimming)
  - Continuous dimming

Lighting Controls

LIGHTING LEVEL BASED CONTROLS

Photocells/Sensors

- Photocells on/off
- Photosensor variable to amount of ambient light
- Generally used with dimming or “staged” lighting systems
- Can be used to compensate for both natural light levels and lamp lumen depreciation.

Lighting Controls

Energy Savings from Lighting Controls

- Typically 35%-45% in Commercial and Institutional Buildings
  - California Energy Commission
- 58 Office Study – 43% Energy Savings from Occupancy Sensors increases to 61% when combined with manual dimming capability
  - Lighting Research Center

QUESTIONS ?