Commercial Requirements for the 2009 IECC and 90.1-2007

Workshop 2
Introductions

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Code officials
    Name
    Municipality
    Status of Commercial Codes
Overview

Project funded by the Missouri Department of Natural Resources (MDNR) with American Recovery and Reinvestment Act of 2009 (ARRA) funding.

2 Locations:
- St. Louis
- Springfield

Objective of the Workshop: Work with municipalities and counties across the state to identify opportunities to adopt or enhance compliance with the 2009 International Energy Conservation Code (IECC) at a local level.
Overview

The “Local Energy Code Action Kit” developed by the Building Codes Assistance Project (BCAP) with ARRA funding provides municipalities and counties in Missouri with information and resources to support the adoption of the model energy code 2009 IECC.

A copy of the report is included with your materials.

The Building Energy Codes Program (BECP) works with the ICC, ASHRAE, IESNA, American Institute of Architects (AIA), the building industry, and state and local officials to develop and promote more stringent and easy-to-understand building energy codes and to assess potential code barriers to new energy-efficient technologies.
What are the topics for today?

2. Overview of the requirements of Commercial envelope, mechanical and lighting provisions of the 2009 IECC
3. Process
## Agenda

<table>
<thead>
<tr>
<th>Topic</th>
<th>Approx. Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction, Project Background, Workshop Overview</td>
<td>15 minutes</td>
</tr>
<tr>
<td>2009 IECC and 90.1 2007-Highlights</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Overview of the commercial mechanical requirements</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Break</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Overview of the commercial lighting requirements</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Commercial Resources - building data collection checklist and COMcheck</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Summary/Questions</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Total Time</td>
<td>2 Hr 20 Min</td>
</tr>
</tbody>
</table>
Some Important Points

Overall
• Focused on commercial
• Discussion-based
• Forum for ideas and practices

What can you expect?
• Code citations in [ ]
• Printed slides

Before we get started...
• Cell phones
Topic 1

Highlights of the Commercial portion of the 2009 IECC and of ASHRAE 90.1 2007
Comparison of 2009 IECC and ASHRAE 90.1-2007

**2009 IECC**
- 2009 IECC developed by the *International Code Council (ICC)*
- New version every three years with more stringent requirements

**ASHRAE**
- ASHRAE 90.1-2007 developed by *American Society for Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)*
- ASHRAE 90.1 is the referenced standard in IECC
- Compliance with ASHRAE 90.1-2007 results in 4% more energy savings than ASHRAE 90.1-2004
Building Energy Codes

ASHRAE Standard 90.1

International Energy Conservation Code

State and Locally Adopted Codes
<table>
<thead>
<tr>
<th>Title</th>
<th>Type</th>
<th>Applicability</th>
<th>Common Versions</th>
</tr>
</thead>
</table>
Commercial Provisions Contained in Chapter 5

- IECC
- ASHRAE 90.1-2007

Section 501.2 “Application” requires 90.1 to be used in its entirety (Envelope, Lighting, Mechanical) if used as an alternate compliance path.
IECC or ASHRAE 90.1

Both IECC & ASHRAE 90.1 apply, either used to comply

Both IECC & ASHRAE 90.1 apply, ASHRAE 90.1 likely used
2009 IECC Compliance

- Must the Project Comply with the IECC?
  - Comply with the Envelope Requirements
    - Section 502
    - 90.1 Section 5
  - Comply with the Mechanical/SWH Requirements
    - Sections 503 and 504
    - 90.1 Section 6
  - Comply with the Power & Lighting Requirements
    - Section 505
    - 90.1 Section 9

- Document Compliance with the IECC
- Plan Review
- Inspection
Commercial State Energy Code Status (*)

(*) as of November 1, 2011, DOE – Building Energy Codes Program
Topic 2

Overview of the requirements of Commercial envelope, lighting and mechanical provisions of the 2009 IECC
Introduction to the Energy Code Compliance Process

Must the Project Comply with the IECC?

- Comply with the Envelope Requirements
  - Section 502
  - 90.1 Section 5

- Comply with the Mechanical/SWH Requirements
  - Sections 503 and 504
  - 90.1 Section 6

- Comply with the Lighting Requirements
  - Section 505
  - 90.1 Section 9

Document Compliance with the IECC

Plan Review

Inspection
Section 503 Building Mechanical Systems

Simplified to Include Only Four Sections:

• What Provisions of the Code Apply (503.1)
• Mandatory Provisions (503.2)
• Simple HVAC Systems and Equipment (503.3)
• Complex HVAC Systems and Equipment (503.4)
What Provision of the Code Apply? (503.1)

Mandatory Provisions – Section 503.2 PLUS
• Section 503.3 (Simple Systems) or
• Section 503.4 (Complex Systems)
Simple Versus Complex Systems

- Simple systems
- Unitary or packaged HVAC equipment
- Serves one zone and controlled by a single thermostat

Section 503.3 Simple Systems

Buildings served by unitary or packaged HVAC each serving 1 zone controlled by 1 thermostat. Two-pipe heating systems serving multiple zones are included if no cooling system is installed [Tables 503.2.3(1) through 503.2.3(5)]
Simple Versus Complex Systems

- Complex systems
- All equipment not covered under Section 503.3 Simple Systems

Section 503.4 Complex Systems

All buildings served by HVAC systems not covered under 503.3
Mandatory Provisions Applicable to ALL Mechanical Systems (503.2)

- HVAC Load Calculations
- Equipment and System Sizing
- HVAC Equipment Performance Requirements
- HVAC System Controls
- Ventilation
HVAC Load Calculations (503.2.1)

Heating and cooling load sizing calculations required

- ASHRAE/ACCA Standard 183
- Other approved computation procedures – defined in Chapter 3
  - Exterior design conditions
    » Specified by ASHRAE
  - Interior design conditions
    » Specified by Section 302 of the IECC
    » $\leq 72^\circ F$ for heating load
    » $\geq 75^\circ F$ for cooling load
Equipment and System Sizing (503.2.2)

• Output capacity SHALL NOT exceed sizing –
• Select the system which serves the greater load, heating or cooling
HVAC Performance (Minimum Efficiency) Requirements (503.2.3)

- Applies to all equipment used in heating and cooling of buildings
- Must comply with all listed efficiencies
Table 503.2.3(2)

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>MINIMUM EFFICIENCY$^*$</th>
<th>TEST PROCEDURE$^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air cooled, (Cooling mode)</td>
<td>&lt; 65,000 Btu/h</td>
<td>Single package</td>
<td>13.0 SEER</td>
<td>AHRI 210/240</td>
</tr>
<tr>
<td></td>
<td>≥ 65,000 Btu/h and &lt; 135,000 Btu/h</td>
<td>Split system and single package</td>
<td>10.1 EER$^c$ (before Jan 1, 2010)</td>
<td>AHRI 340/360</td>
</tr>
<tr>
<td></td>
<td>≥ 135,000 Btu/h and &lt; 240,000 Btu/h</td>
<td>Split system and single package</td>
<td>9.3 EER$^c$ (before Jan 1, 2010)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥ 240,000 Btu/h</td>
<td>Split system and single package</td>
<td>9.0 EER$^c$ 9.2 IPLV$^v$ (before Jan 1, 2010)</td>
<td>AHRI 340/360</td>
</tr>
<tr>
<td>Through-the-Wall (Air cooled, cooling mode)</td>
<td>&lt; 30,000 Btu/h</td>
<td>Single package</td>
<td>10.9 SEER (before Jan 23, 2010)</td>
<td>AHRI 210/240</td>
</tr>
<tr>
<td>Water Source (Cooling mode)</td>
<td>&lt; 17,000 Btu/h</td>
<td>80°F entering water</td>
<td>11.2 EER</td>
<td>AHRI/ASHRAE 13256-1</td>
</tr>
<tr>
<td></td>
<td>≥ 17,000 Btu/h and &lt; 135,000 Btu/h</td>
<td>80°F entering water</td>
<td>12.0 EER</td>
<td>AHRI/ASHRAE 13256-1</td>
</tr>
<tr>
<td>Groundwater Source (Cooling mode)</td>
<td>&lt; 135,000 Btu/h</td>
<td>59°F entering water</td>
<td>16.2 EER</td>
<td>AHRI/ASHRAE 13256-1</td>
</tr>
<tr>
<td>Ground source (Cooling mode)</td>
<td>&lt; 135,000 Btu/h</td>
<td>77°F entering water</td>
<td>13.4 EER</td>
<td>AHRI/ASHRAE 13256-1</td>
</tr>
<tr>
<td>Air cooled (Heating mode)</td>
<td>&lt; 65,000 Btu/h (Cooling capacity)</td>
<td>Single package</td>
<td>7.7 HSPF</td>
<td>AHRI 210/240</td>
</tr>
<tr>
<td></td>
<td>≥ 65,000 Btu/h and &lt; 135,000 Btu/h (Cooling capacity)</td>
<td>47°F db/43°F wb Outdoor air</td>
<td>3.2 COP (before Jan 1, 2010)</td>
<td>AHRI 340/360</td>
</tr>
<tr>
<td></td>
<td>≥ 135,000 Btu/h (Cooling capacity)</td>
<td>47°F db/43°F wb Outdoor air</td>
<td>3.1 COP (before Jan 1, 2010)</td>
<td>AHRI 340/360</td>
</tr>
</tbody>
</table>

(continued)
Table 503.2.3(3)

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY (INPUT)</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>MINIMUM EFFICIENCY</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTAC (Cooling mode) New construction</td>
<td>All capacities</td>
<td>95°F db outdoor air</td>
<td>12.5 - (0.213 · Cap/1000) EER</td>
<td>ARI 310/380</td>
</tr>
<tr>
<td>PTAC (Cooling mode) Replacements</td>
<td>All capacities</td>
<td>95°F db outdoor air</td>
<td>10.9 - (0.213 · Cap/1000) EER</td>
<td></td>
</tr>
<tr>
<td>PTHP (Cooling mode) New construction</td>
<td>All capacities</td>
<td>95°F db outdoor air</td>
<td>12.3 - (0.213 · Cap/1000) EER</td>
<td></td>
</tr>
<tr>
<td>PTHP (Cooling mode) Replacements</td>
<td>All capacities</td>
<td>95°F db outdoor air</td>
<td>10.8 - (0.213 · Cap/1000) EER</td>
<td></td>
</tr>
<tr>
<td>PTHP (Heating mode) New construction</td>
<td>All capacities</td>
<td>—</td>
<td>3.2 - (0.026 · Cap/1000) COP</td>
<td></td>
</tr>
<tr>
<td>PTHP (Heating mode) Replacements</td>
<td>All capacities</td>
<td>—</td>
<td>2.9 - (0.026 · Cap/1000) COP</td>
<td></td>
</tr>
</tbody>
</table>

For SI: °C - °F = 32 / 1.8, 1 British thermal unit per hour = 0.2931 W
db = dry-bulb temperature, °F
wb = wet-bulb temperature, °F

a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
b. Cap means the rated cooling capacity of the product in Btu/h. If the unit’s capacity is less than 7,000 Btu/h, use 7,000 Btu/h in the calculation. If the unit’s capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.
c. Replacement units must be factory labeled as follows: “MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY. NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS.” Replacement efficiencies apply only to units with existing sleeves less than 16 inches (406 mm) high and less than 42 inches (1067 mm) wide.
System Controls (503.2.4)

One temperature and humidity (when applicable) controller per zone
System Controls

Heat pump systems
Heat pump thermostat required
Demand Controlled Ventilation (503.2.5.1)

DCV must be provided for each zone with spaces > 500 ft² and the average occupant load > 40 people/1000 ft² of floor area where the HVAC system has:

- An air-side economizer,
- Automatic modulating control of the outdoor air damper,
- A design outdoor airflow > 3,000 cfm
Demand Controlled Ventilation (503.2.5.1) - Exceptions

- Systems with energy recovery per 503.2.6
- Multiple zone systems without direct digital control of single zones communicating with central control panel
- Systems with design outdoor airflow < 1,200 cfm
- Spaces where supply airflow rate minus any makeup or outgoing transfer air requirement < 1,200 cfm
Energy Recovery Ventilation Systems (503.2.6)

- Applies to individual fan systems with Design supply air capacity ≥ 5,000 cfm
- Minimum outside air supply of ≥ 70% of design supply air quantity
- Exhaust air recovery efficiency must be ≥ 50%
Duct and Plenum Insulation and Sealing (503.2.7)

Required for supply and return ducts and plenums

- Insulating ducts and plenums:
  - Located in unconditioned space - R5
  - Located outside the building - R8
Piping Insulation (503.2.8)

All piping serving heating or cooling system must be insulated in accordance with Table 503.2.8

<table>
<thead>
<tr>
<th>FLUID</th>
<th>NOMINAL PIPE DIAMETER (thickness in inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ 1.5”</td>
</tr>
<tr>
<td>Steam</td>
<td>1 ½</td>
</tr>
<tr>
<td>Hot water</td>
<td>1 ½</td>
</tr>
<tr>
<td>Chilled water, brine or</td>
<td>1 ½</td>
</tr>
<tr>
<td>refrigerant</td>
<td></td>
</tr>
</tbody>
</table>
Exceptions to Table 503.2.8

- Internal piping, factory installed and tested
- Factory installed within room fan-coils and unit ventilators
- Tested and rated to AHRI 440 (except sampling and variation provisions in Section 6.5) and 840
- Piping for fluid in temperature range
HVAC System

Completion (503.2.9)

- Air System Balancing
- Hydronic System Balancing
- Equipment Capacity and Required Maintenance

Design and Control (503.2.10)

- HVAC systems with total fan system power > 5 hp to meet 503.2.10.1 and 503.2.10.2
- Allowable Fan Floor Horsepower
- Motor Nameplate Horsepower
Motor Nameplate Horsepower

- Selected fan motor to be no larger than first available motor size greater than bhp
- Fan bhp on design documents

Exceptions:
- Fans < 6 bhp, where first available motor larger than bhp has nameplate rating within 50% of bhp, next larger nameplate motor size may be selected
- Fans ≥ 6 bhp, where first available motor larger than bhp has nameplate rating within 30% of bhp, next larger nameplate motor size may be selected

*bhp = brake horsepower
Heating Outside a Building (503.2.11)

- To be radiant systems
- Controlled by an occupancy sensing device or timer switch
- So system is automatically de-energized when no occupants are present
Simple HVAC Systems and Equipment (503.3)

Unitary or packaged, single zone controlled by a single thermostat in the zone served. Includes:

**Simple Systems**
- Unitary packaged cooling system
- Split system cooling
- Packaged terminal A/C
- Heat pump cooling
- Unitary packaged heating
- Split system heating
- Packaged terminal heat pump

- Fuel-fired furnace
- Electrical resistance heating
- Two-pipe heating systems w/o cooling
- Economizers
Economizers (503.3.1)

Table 503.3.1(1)

<table>
<thead>
<tr>
<th>CLIMATE ZONES</th>
<th>ECONOMIZER REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A, 1B, 2A, 7, 8</td>
<td>No requirement</td>
</tr>
<tr>
<td>2B, 3A, 3B, 3C, 4A, 4B, 4C, 5A, 5B, 5C, 6A, 6B</td>
<td>Economizers on cooling systems (\geq 54,000) Btu/h(^{a})</td>
</tr>
</tbody>
</table>

\(^{a}\) The total capacity of all systems without economizers shall not exceed 480,000 Btu/h per building, or 20 percent of its air economizer capacity, whichever is greater.
Economizers (503.3.1)

Trade-off high cooling efficiency for economizer

Table 503.3.1(2)

<table>
<thead>
<tr>
<th>CLIMATE ZONES</th>
<th>COOLING EQUIPMENT PERFORMANCE IMPROVEMENT (EER OR IPLV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2B</td>
<td>10% Efficiency Improvement</td>
</tr>
<tr>
<td>3B</td>
<td>15% Efficiency Improvement</td>
</tr>
<tr>
<td>4B</td>
<td>20% Efficiency Improvement</td>
</tr>
</tbody>
</table>
Complex HVAC Systems and Equipment (503.4)

**Complex Systems**

- Packaged VAV reheat
- Built-up VAV reheat
- Built-up single-fan, dual-duct VAV
- Built-up or packaged dual-fan, dual-duct VAV
- Four-pipe fan coil system with central plant

- Hydronic heat pump with central plant
- Any other multiple-zone system
- Hydronic space heating system
- Economizers

This section applies to all HVAC equipment and systems not included in Section 503.3

This section applies to all HVAC equipment and systems not included in Section 503.3
Economizers (503.4.1)

Air side economizer requirements and equipment performance exceptions in Tables 503.3.1(1) and 503.3.1(2)

Water side economizer requirements

Capable of providing 100% of the cooling system load at 50°F dry bulb/45°F wet bulb.
Variable Air Volume Fan Control (503.4.2)

Individual fans with motors ≥ 10hp
• Driven by a mechanical or electrical variable speed drive

OR
• Have controls or devices to result in fan motor demand ≤ 30% of their design wattage at 50% of design airflow when static pressure set point = 1/3 of the total design static pressure
Hydronic System Controls (503.4.3)

Limit reheat/recool of fluids

• Multiple-packaged boiler systems designed to deliver conditioned water/steam into common distribution system

• Automatic controls capable of sequencing operation of the boilers
Hydronic System Controls (503.4.3)

Limit reheat/recool of fluids
- Single boilers > 500,000 Btu/h input design capacity
- Multi-staged or modulating burner required
Hydronic Systems (503.4.3)

- 3-Pipe System
- Can’t use a common return
- 2-Pipe Changeover System
- Dead band between changeover $\geq 15^\circ$F outside temperature
Hydronic Water Loop Heat Pump Systems (503.4.3.3)

Temperature dead band of at least 20ºF (503.4.3.3.1)

- Exception: where system loop temp optimization controller is installed and can determine the most efficient operating temp based on realtime conditions of demand and capacity
- Heat rejection equipment in Climate Zones 3 and 4 (503.4.3.3.2)
• Heat rejection equipment in Climate Zones 5 - 8
• Open- or closed-circuit cooling tower used
• Must have a separate heat exchanger to isolate cooling tower from heat pump loop
• Heat loss controlled by shutting down circulation pump on cooling tower loop and providing an automatic valve to stop flow of fluid
• Two position valve (503.4.3.3.3)
• Required on each hydronic heat pump with total pump system power > 10 hp
Part Load Control (503.4.3.4)

- System $\geq$ 300,000 Btu/h
- Automatic Resets for Supply Water Temperature by 25% of Design Supply-to-Return Temperature Differences or
- Reduce System Pump Flow by 50% of Design Flow Using
- Multiple Staged Pumps
- Adjustable Speed Drives
- Control Valves with Modulate or Step Down Capabilities
Pump Isolation (503.4.3.5)

- Multiple chiller chilled water plants
- Capability to reduce flow automatically when chiller is shut down
- Chillers piped in series considered one chiller
Heat Rejection Equipment Fan Speed Control (503.4.4)

Each fan powered by a motor ≥ 7.5 hp to have capability to operate that fan at 2/3 of full speed or less

- Have controls to automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device

Exception

- Factory-installed heat rejection devices within HVAC equipment tested and rated in accordance with Tables 503.2.3(6) and 503.2.3(7)
Multiple Zone System Requirements (503.4.5)

• VAV Systems must be designed and capable of being controlled to reduce the primary air supply to each zone before reheat, recool, or mixing take place
• Options
  – 30% of the maximum supply air to each zone
  – <300 cfm where the maximum flow rate is <10% of total fan system supply airflow rate
  – Minimum ventilation requirements from Chapter 4 of the IMC
Variable Air Volume System or Zone Exceptions

- Zones with special pressurization or cross-contamination requirements
- Where 75% of reheat energy comes from site-recovered or site-solar energy source
- Zones with special humidity requirements
- Zones with $\leq 300$ cfm peak supply and flow rate is $< 10\%$ of total fan system supply airflow rate
Single Duct VAV Systems, Terminal Devices (503.4.5.1)

Single duct VAV systems to use terminal devices capable of reducing the supply of primary supply air before reheating or recooling takes place.
Supply-Air Temperature Reset Controls (503.4.5.4)

• Multiple zone HVAC systems to have controls to automatically reset supply-air temperature in response to building loads or outdoor air temperature

• Controls to be capable of resetting supply air temperature at least 25% of difference between design supply-air temperature and design room air temperature
Heat Recovery for Service Hot Water Heating (503.4.6)

Most effective where water heater loads are large and well distributed throughout the day

- Typical applications: hotels, dorms, prisons, hospitals
- Condenser heat recovery required for heating/reheating of SWH provided:
- Facility operates 24 hours/day
Section 504 Service Water Heating

- Service water-heating equipment performance efficiency *(504.2)*
- Table 504.2 Minimum Performance of Water-Heating Equipment
- Water Heater Types Covered
  - Electric Storage
  - Gas and Oil Storage
- Instantaneous Water Heaters – Gas and Oil
Pipe Insulation (504.5)

Noncirculating system insulation requirements
• First eight feet of outlet piping on systems with no integral heat traps
• 1/2 inch of insulation required

Circulating systems
• 1 inch of insulation
Hot Water System Controls (504.6)

- Ability to turn off circulating hot water pumps and heat trace tape when the system is not in operation
- Automatically or manually
Pool Requirements (504.7)

Pool heaters (504.7.1)
- Readily accessible on-off switch
- Natural gas or LPG fired pool heaters will not have continuously burning pilot lights

Time switches (504.7.2)
- Automatic controls required to operate pool heaters and pumps on a preset schedule
Pool Covers (504.7.3)

• Heated pools required to have a pool cover
• Pool cover must be vapor retardant
• Pools heated to over 90°F
  – Minimum R-12 insulation
Break

10 minutes

We’re going to start topic 2 again at _____
Topic 3

Overview of the requirements of Commercial envelope, lighting and mechanical provisions of the 2009 IECC
The IECC Code Compliance Process

- Must the Project Comply with the IECC?
  - Comply with the Envelope Requirements
    - Section 502
    - 90.1 Section 5
  - Comply with the Mechanical/SWH Requirements
    - Sections 503 and 504
    - 90.1 Section 6
  - Comply with the Power & Lighting Requirements
    - IECC Section 505
    - 90.1-2007 Section 9

- Document Compliance with the IECC
- Plan Review
- Inspection

IECC Section 506
Building Performance Method
Commercial Lighting Requirements in 2009 IECC

Commercial provisions contained in Chapter 5...with reference to ASHRAE 90.1-2007
Covers lighting controls and power density for interior and exterior
Exception: Lighting within dwelling units
Major changes in the 2009 version
Daylight zone control
New exterior lighting zones
When do the Lighting and Power Requirements Apply?

- Original Installed Lighting System in a New Building, Addition, or Tenant Build-out
- Existing Lighting System that is Altered
- Change in Occupancy that Increases Energy
High-Efficiency Lamps

Defined in the 2009 IECC as:
Compact fluorescent lamps, T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy based on lamp wattage

<table>
<thead>
<tr>
<th>Lamp Wattage</th>
<th>Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 40 watts</td>
<td>60 lumens/watt</td>
</tr>
<tr>
<td>15-40 watts</td>
<td>50 lumens/watt</td>
</tr>
<tr>
<td>&lt; 15 watts</td>
<td>40 lumens/watt</td>
</tr>
</tbody>
</table>
What’s Covered Under Electrical Power and Lighting Systems Requirements?

- Mandatory Interior Lighting requirements
- Required Controls
- Wattage/Efficiency Limits
- Interior Lighting Power Allowances (watts/ft²)
Interior Lighting Control (505.2): Basic Control

Independent Lighting Control required for each space surrounded by floor-to-ceiling partitions

• Must be located in the space served,
  - or -

• Switched from a remote location

• Must have indicator that identifies the lights served and their status (off or on)

Intent: Allow occupants to control unneeded lighting!
Interior Lighting Control: Light Reduction

- Light Reduction Controls must allow the occupant to reduce connected lighting
- By at least 50%
- In a reasonably uniform illumination pattern
- Note: Alternate Standard ASHRAE/IESNA 90.1-2007 does not require Light Reduction Control

Intent: Allow occupants to moderate light levels to save energy!
Light Reduction Control Options

- Controlling all lamps or luminaires
- Dual switching of alternate rows of luminaires, alternate luminaires or lamps
- Switching middle lamp luminaires independently from the outer lamps
- Each luminaire or each lamp
Interior Lighting Control: Light Reduction Exemptions

Light Reduction Control **Not** required for the following:

- Areas with only one luminaire
- Areas controlled by occupancy sensor
- Corridors, storerooms, restrooms or public lobbies
- Sleeping units
- Spaces with <0.6 w/ft$^2$
Interior Lighting Control: Automatic Shutoff

Automatic lighting shutoff control device required in all buildings larger than 5,000 ft\(^2\)

Building Defined:
- “Any structure used or intended for supporting or sheltering any use or occupancy”
- Building area surrounded by exterior walls and fire walls

Exempted spaces
- Sleeping units
- Lighting for patient care
- When an automatic shutoff would endanger occupant safety or security

Intent: Eliminate after hours lighting waste!
Interior Lighting Control: Automatic Shutoff Options

Automatic Lighting Shutoff Compliance Options:

1. **Control lights on a scheduled basis (automatic time switch)**
   - Time-of-day controller
   - Controls ≤ 25,000 ft² and not more than one floor, or

2. **Occupant sensor**
   - Turn lights off within 30 minutes of occupant leaving the space

3. **Signal from another control or alarm that indicates the area is unoccupied**
Interior Lighting Control: Automatic Shutoff Override

- Readily accessible
- Within view of the lights or area controlled
- Manually operated
- ≤ 2 hour override
- Controls an area ≤ 5,000 ft²

Exemptions
- Can be over 2 hour override in malls and arcades, auditoriums, single-tenant retail space, industrial facilities and arenas when using captive key override
- Override in malls and arcades, auditoriums, single-tenant retail space, industrial facilities and arenas can cover up to 20,000 ft²
Daylight Zone Definition – Under Skylights

- The area under skylights whose horizontal dimension, in each direction, is equal to the skylight dimension plus the smaller of:
  - The floor-to-ceiling height, or
  - The distance to a ceiling height opaque partition, or
  - One-half the distance to adjacent skylights or windows
Daylight Zone Definition – Adjacent to Vertical Fenestration

- The daylight zone depth is assumed to be 15 feet into the space or to the nearest ceiling height opaque partition, whichever is less.
- The daylight zone width is assumed to be:
  - the width of the window plus 2 feet on each side, or
  - the window width plus distance to opaque partitions, or
  - the window width plus one-half the distance to adjacent skylight or vertical fenestration, whichever is least.
Daylight Zone Control

Daylight zones

• Must have individual control of the lights independent of general area lighting
• Contiguous daylight zones adjacent to vertical fenestration
• Can be controlled by a single controlling device if the zone doesn’t include areas facing more than two adjacent cardinal orientations (i.e., north, east, south, west)
• Daylight zones under skylights > 15 ft from the perimeter must be controlled separately from daylight zones adjacent to vertical fenestration
Daylight Zone Control

Exception

- Daylight spaces 1) enclosed by walls or ceiling height partitions and 2) containing two or fewer light fixtures
- not required to have a separate switch for general area lighting
- Note: required controls may be manual or automatic
Interior Lighting Control: Sleeping Unit Lighting Control

- Applies to hotels, motels, boarding houses, or similar
- Master switch required at each room or main room entry
- Must control all permanently wired luminaries or switched receptacles
- Exceptions: bathrooms

Intent: Allow occupant to turn off lights at exit point!
Tandem Wiring (505.3)

- Tandem Wiring for all Odd Numbered Lamp Configurations
- Exceptions:
  - Where electronic high frequency ballasts are used
  - Luminaries on emergency circuits
  - Luminaries with no available pair in the same area

Intent: Eliminate the use of magnetic ballasts driving single lamps!
Exit Signs (505.4)

Exit Signs

Internally illuminated exit signs shall not exceed 5 watts per side
Interior Lighting Power Limits (505.5)

Connected Interior Lighting Power must not exceed Interior Lighting Power Allowance
1. Calculate Interior Lighting Power Allowance
   Building Area type allowance
   Additional allowances
2. Calculate proposed connected lighting power
   Wattage calculation “rules”
   Exempted lighting
3. Compare values: proposed wattage must be less than or equal to allowed wattage

Intent: Eliminate waste from sloppy lighting design and application!
Table 505.5.2

Interior Lighting Power Allowances

Building Area Type

<table>
<thead>
<tr>
<th>Building Area Type</th>
<th>Lighting Power Density (W/SF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automotive Facility</td>
<td>0.5</td>
</tr>
<tr>
<td>Convention Center</td>
<td>1.2</td>
</tr>
<tr>
<td>Court House</td>
<td>1.3</td>
</tr>
<tr>
<td>Dining: Bar, Lounge/Lounge</td>
<td>1.3</td>
</tr>
<tr>
<td>Dining: Cafeteria/Fast Food</td>
<td>1.4</td>
</tr>
<tr>
<td>Dining: Family</td>
<td>1.6</td>
</tr>
<tr>
<td>Dormitory</td>
<td>1.0</td>
</tr>
<tr>
<td>Exercise Center</td>
<td>1.0</td>
</tr>
<tr>
<td>Gymnasium</td>
<td>1.1</td>
</tr>
<tr>
<td>Healthcare – Clinic</td>
<td>1.0</td>
</tr>
<tr>
<td>Hospital</td>
<td>1.2</td>
</tr>
<tr>
<td>Hotel</td>
<td>1.0</td>
</tr>
<tr>
<td>Library</td>
<td>1.3</td>
</tr>
<tr>
<td>Manufacturing Facility</td>
<td>1.3</td>
</tr>
<tr>
<td>Model</td>
<td>1.0</td>
</tr>
<tr>
<td>Motion Picture Theater</td>
<td>1.2</td>
</tr>
<tr>
<td>Multi-huey</td>
<td>0.7</td>
</tr>
<tr>
<td>Museum</td>
<td>1.1</td>
</tr>
<tr>
<td>Office</td>
<td>1.0</td>
</tr>
<tr>
<td>Parking Garage</td>
<td>0.3</td>
</tr>
<tr>
<td>Percinialy</td>
<td>1.0</td>
</tr>
<tr>
<td>Performing Arts Theater</td>
<td>1.6</td>
</tr>
<tr>
<td>Police/Fire Station</td>
<td>1.0</td>
</tr>
<tr>
<td>Post Office</td>
<td>1.1</td>
</tr>
<tr>
<td>Religious Building</td>
<td>1.2</td>
</tr>
<tr>
<td>Retail</td>
<td>1.5</td>
</tr>
<tr>
<td>School/University</td>
<td>1.2</td>
</tr>
<tr>
<td>Sports Arena</td>
<td>1.1</td>
</tr>
<tr>
<td>Town Hall</td>
<td>1.1</td>
</tr>
<tr>
<td>Transportation</td>
<td>1.0</td>
</tr>
<tr>
<td>Warehouse</td>
<td>0.8</td>
</tr>
<tr>
<td>Workshop</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Note: Alternate Standard ASHRAE/IESNA 90.1-2007 provides whole building and space-by-space options
Interior Lighting Power Allowance Calculation

First, choose an appropriate “Building Area Type” from the allowance table (505.5.2).

- “Building Area” includes all spaces that are associated with that business or function type. For example a space with:
  - Corridors,
  - Restrooms,
  - A lobby, and
  - Office space

...would be considered an Office Building Area Type

Then...multiply the lighting power density (W/ft²) by the building square footage to get allowed watts for compliance
Office - Example

A 200,000 ft\(^2\) office building that contains corridor, restrooms, break rooms and a lobby is given 1.0 W/ft\(^2\) for the entire building

Office: 200,000 ft\(^2\)
1.0 W/ft\(^2\) = 200,000 W
Interior Lighting Power Allowance for Multiple Occupancy Building

How is an allowance determined if the building has more than one Building Area Type?

Example – A building contains the following area types

Museum: 40,000 ft$^2$
Retail: 5,000 ft$^2$
Cafeteria: 10,000 ft$^2$

Use the more specific building area type where more than one area type exists in the building

Sum the individual (lighting power density X area square footage) values for Total Power Allowance
Multiple Occupancy Building - Example

Museum: 40,000 ft\(^2\)

\[\text{at } 1.1 \text{ W/ft}^2 = 44,000 \text{ W}\]

Cafeteria: 10,000 ft\(^2\)

\[\text{at } 1.4 \text{ W/ft}^2 = 14,000 \text{ W}\]

Retail: 5,000 ft\(^2\)

\[\text{at } 1.5 \text{ W/ft}^2 = 7,500 \text{ W}\]

Total watts allowed = 65,500 W
Additional Retail Lighting Power Allowance (Table 505.5.2 – Footnotes)

Additional Interior Lighting Power Allowance = 1000 watts + (Retail Area 1 x 0.6 W/ft²) + (Retail Area 2 x 0.6 W/ft²) +(Retail Area 3 x 1.4 W/ft²) + (Retail Area 4 x 2.5 W/ft²),

Where:

Retail Area 1 = the floor area for all products not listed in Retail Area 2, 3 or 4.

Retail Area 2 = the floor area used for the sale of vehicles, sporting goods and small electronics.

Retail Area 3 = the floor area used for the sale of furniture, clothing, cosmetics and artwork.

Retail Area 4 = the floor area used for the sale of jewelry, crystal, and china.
Proposed Lighting Power Calculation

Sum the wattage of all proposed connected lighting power

This must include all lighting that is part of the design for the space including:

- Overhead lighting
- Task lighting
- Decorative lighting

Note: Wattage must be calculated based on actual power draw... not just nominal lamp rating
Proposed Lighting Calculation: Rules

Lighting wattage must be documented in accordance with Section 505.5.1
Screw lamp holders: maximum labeled wattage of the luminary
Low voltage lighting: transformer wattage
Line voltage track:
   1. specified wattage with minimum of 30 W/linear ft OR
   2. wattage limit of system’s circuit breaker OR
   3. wattage limit of other permanent current limiting devices
Other: manufacturer’s rated wattage of lamp and associated ballast
Exemptions to Proposed Lighting Power Calculation

- Connected power for following not included in calculations:
  - Professional sports arena playing field
  - Sleeping unit lighting
  - Emergency lighting automatically off during normal building operation
  - Lighting in spaces specifically designed for use by occupants with special lighting needs including visual impairment and other medical and age related issues
  - Lighting in interior spaces specifically designated as a registered interior historic landmark
  - Casino gaming areas

- Lighting equipment used for the following exempt if in addition to general lighting and controlled by an independent control device
  - Task lighting for medical and dental procedures
  - Display lighting for exhibits in galleries, museums and monuments
What if My Proposed Design Does Not Meet Code?

- Check calculations and design
- Appropriate area type allowances used?
- Actual lighting equipment wattages used?
  ...and design
- Reasonable illuminance levels provided?
- Efficient light sources used?
- Use alternate Standard 90.1-2007*
- Use total Building Performance Method

*Section 501.2 Application requires 90.1 to be used in its entirety (Envelope, Lighting, Mechanical) if used as an alternate compliance path
Exterior Lighting Control Requirements (505.2.4)

- For dusk-to-dawn lighting: astronomical time switch or photosensor
- For all other: astronomical time switch OR photosensor + time switch
- All time switches must have 10 hour battery backup
Exterior Efficiency Requirement (505.6.1)

Building grounds lighting luminaires over 100 watts must have source efficacy of at least 60 lumens per watt.

<table>
<thead>
<tr>
<th>Light Source</th>
<th>Typical System Efficacy Range in LPW (varies depending on wattage and lamp type)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incandescent</td>
<td>10-18</td>
</tr>
<tr>
<td>Halogen incandescent</td>
<td>15-20</td>
</tr>
<tr>
<td>Compact fluorescent (CFL)</td>
<td>35-60</td>
</tr>
<tr>
<td>Linear fluorescent</td>
<td>50-100</td>
</tr>
<tr>
<td>Metal halide</td>
<td>50-90</td>
</tr>
</tbody>
</table>
Exterior Lighting Power Limits (505.6.2)

Connected Exterior Lighting Power must not exceed Exterior Lighting Power Allowance

• Calculate exterior Lighting Power Allowance  
  – Lighting power densities by exterior function and by applicable lighting zone

• Calculate proposed connected lighting power  
  – Wattage calculation “rules”  
  – Exempted lighting

• Compare values: proposed wattage must be less than or equal to allowed wattage
Exterior Lighting Power Limits (505.6.2)

What areas are covered under exterior lighting allowances?

- ** Tradable surfaces**
  Common exterior lighted needs that can be traded for other needs. For example, wattage allowed for parking lot lighting can be “traded” and used for canopy lighting.

- ** Nontradable surfaces**
  Less common exterior lighted needs that cannot be traded for other needs. These applications have more specific security or task illuminance needs.
Tradable Surfaces

- Uncovered parking lots and areas
- Walkways (under and over 10 feet wide)
- Stairways
- Pedestrian tunnels
- Main building entrances
- Other doors
Nontradable Surfaces

- Building facades
- Automated teller machines and night depositories
- Entrances and gatehouse inspection stations at guarded facilities
- Loading areas for law enforcement, fire, ambulance and other emergency vehicles
<table>
<thead>
<tr>
<th>Lighting Zone</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Developed areas of national parks, state parks, forest land, and rural areas</td>
</tr>
<tr>
<td>2</td>
<td>Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed use areas</td>
</tr>
<tr>
<td>3</td>
<td>All other areas</td>
</tr>
<tr>
<td>4</td>
<td>High-activity commercial districts in major metropolitan areas as designated by the local land use planning authority</td>
</tr>
</tbody>
</table>
## Exterior Lighting Zones

<table>
<thead>
<tr>
<th>Base Site Allowance</th>
<th>Zone 1</th>
<th>Zone 2</th>
<th>Zone 3</th>
<th>Zone 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>500 W</td>
<td>600 W</td>
<td>750 W</td>
<td>1300 W</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tradable Surfaces</th>
<th>Uncovered Parking Areas</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Parking areas and drives</td>
<td>0.04 W/ft^2</td>
<td>0.06 W/ft^2</td>
<td>0.10 W/ft^2</td>
<td>0.13 W/ft^2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Building Grounds</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Walkways less than 10 feet wide</td>
<td>0.7 W/linear foot</td>
<td>0.7 W/linear foot</td>
<td>0.8 W/linear foot</td>
<td>1.0 W/linear foot</td>
</tr>
<tr>
<td>Walkways 10 feet wide or greater</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plaza areas</td>
<td>0.14 W/ft^2</td>
<td>0.14 W/ft^2</td>
<td>0.16 W/ft^2</td>
<td>0.2 W/ft^2</td>
</tr>
<tr>
<td>Special Feature Areas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stairways</td>
<td>0.75 W/ft^2</td>
<td>1.0 W/ft^2</td>
<td>1.0 W/ft^2</td>
<td>1.0 W/ft^2</td>
</tr>
<tr>
<td>Pedestrian Tunnels</td>
<td>0.15 W/ft^2</td>
<td>0.15 W/ft^2</td>
<td>0.2 W/ft^2</td>
<td>0.3 W/ft^2</td>
</tr>
</tbody>
</table>
## Exterior Lighting Zones con’t

<table>
<thead>
<tr>
<th>Tradable Surfaces</th>
<th>Building Entrances and Exits</th>
<th>Zone 1</th>
<th>Zone 2</th>
<th>Zone 3</th>
<th>Zone 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main entries</td>
<td>20 W/linear foot of door width</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other doors</td>
<td>20 W/linear foot of door width</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entry Canopies</td>
<td>0.25 W/ft²</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales Canopies</td>
<td>Free-standing and attached</td>
<td>0.6 W/ft²</td>
<td>0.6 W/ft²</td>
<td>0.8 W/ft²</td>
<td>1.0 W/ft²</td>
</tr>
<tr>
<td>Outdoor Sales</td>
<td>Open areas (including vehicle sales lots)</td>
<td>0.25 W/ft²</td>
<td>0.25 W/ft²</td>
<td>0.5 W/ft²</td>
<td>0.7 W/ft²</td>
</tr>
<tr>
<td></td>
<td>Street frontage for vehicle sales lots in addition to “open area” allowance</td>
<td>No allowance</td>
<td>10 W/linear foot</td>
<td>10 W/linear foot</td>
<td>30 W/linear foot</td>
</tr>
<tr>
<td>Non-Tradable Surfaces</td>
<td>Building Facades</td>
<td>0.1 W/ft² for each illuminated wall or surface or 2.5 W/linear foot for each illuminated wall or surface length</td>
<td>0.15 W/ft² for each illuminated wall or surface or 3.75 W/linear foot for each illuminated wall or surface length</td>
<td>0.2 W/ft² for each illuminated wall or surface or 5.0 W/linear foot for each illuminated wall or surface length</td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Automated teller machines and night depositories</td>
<td>270 W per location plus 90 W per additional ATM per location</td>
<td>270 W per location plus 90 W per additional ATM per location</td>
<td>270 W per location plus 90 W per additional ATM per location</td>
<td>270 W per location plus 90 W per additional ATM per location</td>
<td></td>
</tr>
<tr>
<td>Entrances and gatehouse inspection stations at guarded fac.</td>
<td>0.75 W/ft² of covered and uncovered area</td>
<td>0.75 W/ft² of covered and uncovered area</td>
<td>0.75 W/ft² of covered and uncovered area</td>
<td>0.75 W/ft² of covered and uncovered area</td>
<td></td>
</tr>
<tr>
<td>Loading areas for law enforcement, fire, ambulance and other emergency service vehicles</td>
<td>0.5 W/ft² of covered and uncovered area</td>
<td>0.5 W/ft² of covered and uncovered area</td>
<td>0.5 W/ft² of covered and uncovered area</td>
<td>0.5 W/ft² of covered and uncovered area</td>
<td></td>
</tr>
<tr>
<td>Drive-up windows/doors</td>
<td>400 W per drive-through</td>
<td>400 W per drive-through</td>
<td>400 W per drive-through</td>
<td>400 W per drive-through</td>
<td></td>
</tr>
<tr>
<td>Parking near 24-hour retail entrances</td>
<td>800 W per main entry</td>
<td>800 W per main entry</td>
<td>800 W per main entry</td>
<td>800 W per main entry</td>
<td></td>
</tr>
</tbody>
</table>
Exemptions from Exterior Calculation (505.6.2)

- The following lighting does not need to be included in the proposed lighting calculation:
  - Specialized signal, directional, and marker lighting associated with transportation
  - Advertising signage or directional signage
  - Lighting integral to *equipment* or instrumentation and installed by its *manufacturer*
  - Lighting for theatrical purposes, including performance, stage, film production, and video production
What if My Proposed Exterior Lighting Does Not Meet Code?

• Check calculations and design
• Appropriate surface allowances used?
• Actual lighting equipment wattages used?
  ...and design
• Reasonable illuminance levels provided?
• Efficient light sources used?
• Use alternate Standard 90.1-2007*
• Use total Building Performance Method

*Section 501.2 Application requires 90.1 to be used in its entirety (Envelope, Lighting, Mechanical) if used as an alternate compliance path
Electrical Energy Consumption Mandatory Requirement (505.7)

Separate metering required for each dwelling unit

Intent: Occupant understanding of actual energy use can promote effective energy use!
Promoting Awareness of 2009 IECC

General Resources

*Top 10 Reasons for Building Energy Codes*, U.S. Dept. of Energy

*Frequently-Asked Questions*, U.S. Dept. of Energy
Topic 3

Commercial Resources, Building Data Collection Checklist and COMcheck
Building data collection checklists

• To “check on” compliance, the first step is to have a proper checklist. BECP offers evaluation checklists for both residential and commercial buildings, complete with instructions to help evaluators.

• The checklists offer weighted scoring in order to focus on the most important code requirements and help states produce accurate metrics.

BECP Tool:
Download inspection checklists and corresponding instructions at:
www.energycodes.gov/arra/compliance_evaluation.stm
Building data collection checklists

1. Commercial Building Data Collection Checklist
   ANSI/ASHRAE/IESNA Standard 90.1-2007

Software

No-cost, easy-to-use software that will demonstrate compliance
Software

No-cost, easy-to-use software that will demonstrate compliance.
www.energycodes.gov/software.stm

Desktop Software Tools

Web-Based Tools

Free

COMcheck™
Windows version or Mac version

COMcheck·Web™

COMcheck Package Generator
Commercial Compliance

**Building System**
- Envelope
- Lighting
- Mechanical
  - HVAC
  - SWH

**Compliance Options**
- Prescriptive Option
- Trade Off Option
- Total Building Performance

**Mandatory Provisions**
(required for most compliance options)

**Energy Code Compliance**
Info You’ll Need

• Basic information about the builder and project
• Area take-offs for exterior walls, fenestration, roof/ceiling, basement walls, floors, etc.
• Insulation R-values, fenestration U-factors, etc.
• Lighting fixture details
• Heating and cooling system details
• Service water heating details
Main Steps

• Select the Appropriate Code
• Enter Project Information
• Enter Building Components
• Enter Interior/Exterior Lighting
• Enter Mechanical Equipment
• View/Print the Compliance Report(s)
• Save the Data File and the Report
Appropriate Code

• Energy code applicable to your state/jurisdiction (Code Menu)
• Status of State Codes
• Default
• Preferences
Navigation Bar

- Edit Menu
- General
- File Options
- Beyond Code Advisor
- Version Update Check
- Project
- Code/location
- Envelope
- Applicant
  - Project Details
- Reports

- Signatures
- Email Reports
Project Information

- Project location
- Project type
- Project details for report (optional)
- Title/Site/Permit
- Owner/Agent
- Designer/Contractor
- Notes
Project Screen
Building Use Types

- Vary by code
- Internal loads
- Lighting power allowances
Building Components

- Only components that separate conditioned space from unconditioned space/outside air
- Only use applicable buttons
- Can group “like” components
- Use of “other” assembly type
- Gross area
Foundations

- **Basement button** – use if
  - basement is conditioned
  - basement walls are insulated
- **Floor button** – use if
  - separates conditioned from unconditioned space *(includes slab-on-grade floor)*
Envelope Screen

- Entries can change based on code and/or location selected
- Assembly types
- *Int. Wall* button
- Projection Factor
- Orientation
Envelope Results

COMcheck Software Version 3.5.3
Envelope Compliance Certificate

2001 IECC
Report Date: 09/13/02
Data Filename: D:\Program Files\Check\COMcheck\05Sample.doc

Section 1: Project Information
Project Type: New Construction
Project Title: 
Construction Site: 
Owner/Agent: 
Designer/Contractor: 

Section 2: General Information
Building Location (for weather data): Bismarck, Montana

Envelope:
Heating Degree Days (base 65 degrees F): 7856
Cooling Degree Days (base 65 degrees F): 202
Vertical Glazing: 25% Area: 

Atrium/Enclosed:
Office: 4500
Conference, Conference or Meeting Center: 400
Gymnasium, Fitness, Support Area: 1400
Estates, Industrial and Commercial: 2500
Industrial Roof < 20 ft Ceiling Height: 2500
Lobby - Other: 833

Section 3: Requirements Checklist

Climate-Specific Requirements:

Component Name/Description | Gross Area or Perimeter (sq. ft) | U-Factor | R-Value | Cont. U-Factor | Proposed U-Factor | Code Factor 
--- | --- | --- | --- | --- | --- | ---
Rooftop: Flat Roof, Insulated | 812 | 22.9 | 0.0 | 0.106 | 0.110 | 
Wall 1: Solid Concrete or Masonry <= 9", Finishing: None, Wall Height 12 ft, Ceiling 8 ft, 7.2 | 2000 | 10.8 | 0.062 | 0.066 | 
Envelope Wall: Solid Concrete or Masonry <= 9", Finishing: None, Wall Height 12 ft, Ceiling 8 ft, 7.2 | 107 | 10.8 | 0.062 | 0.066 | 
Through Wall: Metal Frame, Double Pane, 1.0 | 1611 | 10.8 | 0.062 | 0.066 | 
Through Wall: Metal Frame, Double Pane, 1.0 | 1611 | 10.8 | 0.062 | 0.066 | 
Through Wall: Metal Frame, Double Pane, 1.0 | 1611 | 10.8 | 0.062 | 0.066 | 
Through Wall: Metal Frame, Double Pane, 1.0 | 1611 | 10.8 | 0.062 | 0.066 | 
Through Wall: Metal Frame, Double Pane, 1.0 | 1611 | 10.8 | 0.062 | 0.066 | 
Through Wall: Metal Frame, Double Pane, 1.0 | 1611 | 10.8 | 0.062 | 0.066 | 
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Through Wall: Metal Frame, Double Pane, 1.0 | 1611 | 10.8 | 0.062 | 0.066 | 
Through Wall: Metal Frame, Double Pane, 1.0 | 1611 | 10.8 | 0.062 | 0.066 | 
The completed checklist includes the designated climate-specific requirements for the project.
Interior Lighting

- Mandatory requirements
- Interior lighting power requirements
- Complies if total connected power is less than interior lighting power allowance (entire building or partial building)

Proposed Wattage \( \leq \) Allowed Wattage
Interior Lighting

- LPDs based on Building Use on Project screen
- Add fixtures
- Identify exemptions and allowances (if applicable)

<table>
<thead>
<tr>
<th></th>
<th>Component</th>
<th>Fixture ID</th>
<th>Fixture Description</th>
<th>Lamp Description/ Wattage Per Lamp</th>
<th>Ballast</th>
<th>Lamps Per Fixture</th>
<th>Number of Fixtures</th>
<th>Fixture Wattage</th>
</tr>
</thead>
</table>
Exemptions and Allowances

Options menu
Based on code selected

Exemptions
• Power for exempt fixtures is omitted from the *proposed wattage*

Allowances
• *Allowed wattage* for building increased by allowable amount
Interior Lighting Results
Exterior Lighting

• Based on code selected
• Mandatory requirements
• Exemptions

| Total Connected Power | < | Ext. Ltg. Power Allowance |
Exterior Lighting

- Pay attention to Quantity and Units
- Tradable
  - Common applications where unused power can be traded where needed
- Non-Tradable
  - Less common applications that cannot be traded
Exterior Lighting Results

2006 IECC
Exterior Lighting Compliance Certificate

Section 1: Project Information
Project Type: New Construction
Project Title:
Construction Site:
Owner/Agent:
Design/Contractor:

Section 2: Exterior Lighting Area/Surface Power Calculation

<table>
<thead>
<tr>
<th>Exterior Aisle/Wall Surface</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doorway window</td>
<td>4</td>
<td>600</td>
<td>180</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>Back entrance</td>
<td>1</td>
<td>120</td>
<td>40</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Exterior lighting (n)</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>180</td>
</tr>
<tr>
<td>Gallery - 15 feet wide</td>
<td>1</td>
<td>Yes</td>
<td>720</td>
<td>720</td>
<td>720</td>
</tr>
</tbody>
</table>

Total (sum of columns B, C, D, E, F):

Section 3: Exterior Lighting Fixture Schedule

<table>
<thead>
<tr>
<th>Exterior Aisle/Wall Surface</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doorway window</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Back entrance</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Exterior lighting (n)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gallery - 15 feet wide</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Total (sum of columns E, F, G):

Section 4: Requirements Checklist

Lighting Wattage:

- [ ] Voltage is within recommended range, total proposed watts must be less than or equal to total allowed watts. Across all fixture wattages, total allowed watts must be less than or equal to total proposed watts.

Compliance Validation: Use supplemental assurance tools.

Controls, Switching, and Wiring:
Mechanical Equipment

Works differently than Envelope and Lighting
Enter characteristics of:
• HVAC system
• Plant
• Water heating
Generates a customized list of requirements
Mechanical Report

2008 IECC

Section 1: Project Information
Project Type: New Construction
Building Site:
Owner/Agent:
Designer/Contractor:

Section 2: General Information
Building Location (city): Buchanan, Montana
Climate Zone: 9b
Heating Degree Days (base 65 degrees F): 10380
Cooling Degree Days (base 65 degrees F): 1959

Section 3: Mechanical Systems List

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Equipment Type &amp; Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>RT-2 &amp; RT-3 - Pkg. gas/elec.</td>
</tr>
<tr>
<td>1</td>
<td>OU-1 - Condensing unit, Btu/h: 155746, Gas, Nat. Gas</td>
</tr>
<tr>
<td>1</td>
<td>Unit heater - Unit heater, Gas</td>
</tr>
<tr>
<td>1</td>
<td>F-1 - Gas furnace Heating, Central Furnace, Gas</td>
</tr>
</tbody>
</table>

Section 4: Requirements Checklist

Requirements Specific To: RT-2 & RT-3 - Pkg. gas/elec.: 

- [ ] 1. Newly purchased heating equipment meets the heating efficiency requirements
- [ ] 2. Specified equipment consists of non-weatherized components - efficiency documentation provided
- [ ] 3. Cooling system provides a means to release excess outdoor air during economizer operation
- [ ] 4. Integrated air economizer required

Requirements Specific To: OU-1 - Condensing unit: 

- [ ] 1. Specified equipment consists of non-weatherized components - efficiency documentation provided
- [ ] 2. Cooling system provides a means to release excess outdoor air during economizer operation
- [ ] 3. Integrated air economizer required

Requirements Specific To: UM-1 - Gas unit heater: 

- [ ] 1. Equipment minimum efficiency: Unit heater (gas) 80%

Requirements Specific To: F-1 - Gas furnace: 

- [ ] 1. Newly purchased heating equipment meets the heating efficiency requirements

Generic Requirements: Must be met by all systems to which the requirement is applicable:
Mandatory Requirements

• Must be met by all buildings
• Included in compliance report(s)
• Viewable in software Help
Help

Welcome

Quick Start
Project Screen
Envelope Screen
Lighting Screen
Mechanical Screen
Building Use Types
Screen Operations
Mandatory Requirements

Missouri Department of Natural Resources
Screen Operations

Compliance Bar
Status Bar
Screen Operations

Compliance Bar
Status Bar
Colors - **Red**
Screen Operations

Compliance Bar
Status Bar
Colors - Green
Screen Operations

Compliance Bar
Status Bar
Colors - Blue
Screen Operations

Compliance Bar
Status Bar
Colors
Right Mouse Button
“Context” Menu
Files

Data (File ➔ Save)
Report (File ➔ Save Report)
Exchange

COMcheck-Web is the web-based version of the COMcheck desktop software. It performs just like the desktop version, but you don’t need to download or install any software on your computer.
Additional COMcheck Training Opportunities

- COMcheck 101
- COMcheck 201
- Case studies

www.energycodes.gov