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September 19, 2017

Via Hand Delivery

Ms. Lora W. Johnson
Clerk of Council
Council of the City of New Orleans
Room 1E09, City Hall
1300 Perdido Street
New Orleans, LA 70112

Re: ***Filing of the New Orleans Technical Resource Manual (Resolutions R-15-140; UD-08-02)***

Dear Ms. Johnson:

On April 9, 2015, the Council of the City of New Orleans ("Council") adopted Resolution R-15-140 that directed Entergy New Orleans, Inc.'s ("ENO") to create a New Orleans Reference Manual. On behalf of ADM Associates, ENO submits the enclosed original and three copies of the New Orleans Technical Resource Manual. Should you have any questions regarding this filing, please contact my office at (504) 670-3680.

Thank you for your assistance with this matter.

Sincerely,

Gary E. Huntley

Enclosures
cc: Official Service List UD-08-02 *(via electronic mail)*

RECEIVED
SEP 19 2017
BY:

New Orleans Energy Smart
Technical Reference Manual: Version 1.0

September 15, 2017

Prepared by:

ADM Associates, Inc.

Acknowledgements

ADM Associates would like to thank the parties involved in the development of the New Orleans Technical Reference Manual. The City Council Advisors, Entergy New Orleans, and Energy Smart program implementation contractors have contributed significantly to this effort, and we appreciate the opportunity to provide this document in an effort to inform the continuous improvement of the Energy Smart Programs.

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A. Introduction

This Technical Reference Manual (TRM) provides Unit Energy Savings (UES, or "deemed savings") estimates of kWh (energy savings) and kW (demand reductions) for the Entergy New Orleans Energy Smart Programs. The selection of measures for inclusion in this TRM was based on:

1. Historical implementation rates of measures;
2. Identification of measures in other programs that may warrant inclusion in Energy Smart; and
3. An assessment of whether a measure is an appropriate candidate for deemed savings or if it warrants custom analysis. Some viable measures (such as HVAC variable frequency drives, or VFDs) have been excluded from this TRM as they are more appropriate for custom analysis.

A.1. High Impact Measures

In this TRM, we refer to "High Impact Measures" (HIMs). Measures are classified as HIMs if they exceed a minimum of 1% of the sector-level savings for the residential or non-residential components of Energy Smart. Most HIMs have deemed savings parameters based off primary research conducted by ADM Associates (ADM) as part of the Program Year 5 (PY5) and Program Year 6 (PY6) evaluation, measurement, and verification (EM&V) efforts. Measures that are not HIMs have savings values that are typically either direct reference to existing sources (such as ENERGY STAR®, Food Service Technology Center, the Department of Energy, or the California Database for Energy Efficient Resources (DEER)). These measures have been updated to reflect New Orleans weather where appropriate.

The HIMs are summarized in the subsections to follow.

A.1.1. Residential High Impact Measures

The following list includes all measures that produced a minimum of 1% of residential Energy Smart gross energy savings (kWh) in PY6.

- Duct Sealing: 54.6%
- Lighting: 13.9%
- Air Sealing: 11.8%
- Ceiling Insulation: 7.8%
- Central AC Tune-Up: 7.2%
- Low Flow Shower Heads: 2.8%
- Central AC Replacement: 1.0%

To-date, the EM&V activities have included primary research to refine savings estimates for all residential HIMs other than ceiling insulation and air sealing. The primary research informed 79.5% of Energy Smart PY6 residential savings. Ceiling insulation and air sealing are targeted for primary research in PY7. Their savings in this TRM are based on simulation results only. We note here that the percentages detailed above are percent of verified gross energy savings (kWh). Increased emphasis was placed on HVAC measures as their initial claimed savings were significantly higher; EM&V findings reduced gross savings for these measures by a minimum of 70% in each of PY5 and PY6 evaluations.

A.1.2. Commercial & Industrial (C&I) High Impact Measures

This following list includes all measures that produced a minimum of 1% of residential Energy Smart savings in Program Year 6 (PY6).

- Lighting: 89.7%
- Custom: 9.0%

Custom measures are not included in the TRM, and receive analysis unique to the facility based on the International Measurement & Verification Protocols (IPMVP). Though metering studies have not been completed for all facility types, the adjustments to New Orleans-specific projects has been significant. The primary research informed 98.7% of Energy Smart PY6 C&I savings.

A.2. New Orleans EM&V Studies

The following EM&V studies have been completed, allowing for incorporation of primary data into the TRM:

- Metering of residential air conditioning runtime, applied to AC replacement and duct sealing;
- Field assessment of average SEER for air conditioning units in duct sealing projects;
- Billing analysis to support reductions achieved from residential air conditioning tune-ups;
- Measurement of residential domestic hot water (DHW) temperature setpoints, incorporated into DHW replacements and low flow devices;
- Metering of residential lighting run-time;
- Metering of commercial lighting run-time for the following facility types:
    - K-12 Education;
    - Exterior Lighting (all commercial);
    - Food Preparation;
    - Food Sales: Non-24 Hour Supermarket;
    - Food Service: Fast Food;
    - Food Service: Sit-down Restaurant;
    - Health Care: In-Patient;

- o Lodging: Common Areas;
- o Lodging: Guest Rooms;
- o Multifamily: Common Area;
- o Religious Assembly/Worship;
- o Retail: Freestanding; and
- o Warehouse: Non-Refrigerated.

The data collected for these studies is summarized in Table 1 below.

Table 1: Parameters Validated with Primary Data Collection in New Orleans

Parameter	***Measures Affected***	***Value***	***Sample Size***
Residential Cooling Equivalent Full-load Hours	Duct Sealing, AC replacement, AC tune-up	1,637	68 homes
Residential Cooling Peak Coincidence Factor	Duct Sealing, AC replacement, AC tune-up	77%	68 homes
Lighting hours of use	CFLs, Specialty CFLs, Directional LEDs, Omnidirectional LEDs	2.24	40 homes, 176 loggers
Residential Lighting Peak Coincidence Factor	CFLs, Specialty CFLs, Directional LEDs, Omnidirectional LEDs	12.75%	40 homes, 176 loggers
Residential DHW Setpoint (deg. F)	Water Heater Replacement, Faucet Aerators, Low Flow Showerheads	122.24	37 homes
Residential AC Tune-Up Annual % Savings	AC Tune-Up	10.1%	260
Commercial Lighting Hours of Use	Commercial Lighting	Original values created for 10 facility types. See Section C.6.3.5	59 premises, 210 loggers
Commercial Lighting Peak Coincidence	Commercial Lighting	Original values created for 10 facility types. See Section C.6.3.5	59 premises, 210 loggers

A.3. Incremental Costs

The TRM also provides incremental cost values for most measures. Incremental cost is defined under two possible scenarios:

- Normal replacement / New construction / Replace-on-burnout: these costs reflect the cost premium of efficient equipment compared to minimum code-compliant equipment.
- Early replacement: these costs reflect the full installed cost of the new equipment. For some measures, such as lighting controls, this is meant to capture that the measure is an add-on to existing equipment. For measures that have parameters defined for the early replacement of functioning equipment, this approach also includes the subtraction of the net present value (NPV) of the second equipment purchase.

A.4. Measure Incentive Levels

Though the TRM does not prescribe measure levels, program administrators should account for the incremental cost assumptions detailed herein when establishing incentives for energy efficiency programs.

The following guidelines should be considered:

- Incentives for low income programs should cover 100% of project costs; low income customers are unlikely to have the financial ability to meaningfully engage with Energy Smart programs if a copay is required of them.
- Incentives should never exceed incremental costs. All measures detailed in the TRM have incremental cost assumptions. If an incentive is to exceed this amount the program administrator must provide documentation detailing how the specific project had costs exceeding the stipulated incremental cost.
- For residential programs that do not exclusively service the low-income market ("mass-market programs"), incentive levels should differentiate between retail markdown lighting and other program channels.
    - Markdown lighting: rebates should not exceed 60% of incremental costs.
    - Lighting in other program channels: rebates can be up to 10% of incremental costs. This allows for program mechanisms such as school kits and direct install without copay.
    - Rebates for non-lighting measures (HVAC, envelope, appliances, etc.) may be up to 100% of incremental costs. However, program administrators are encouraged to identify programs or measures where a customer copay is appropriate in order to ensure good stewardship of ratepayer funds and to maintain appropriate levelized costs of savings. Measures that receive 100% funding in a mass-market program will be reviewed by the EM&V contractor in order to determine whether the incentive level is appropriate for the measure or program.

- The Energy Smart programs currently cap incentives at 100% of project cost or $50,000, whichever is lower. This is an adequate cost control system and is consistent with other regional programs (Arkansas, Texas, Mississippi). As programs mature, Energy Smart program staff should endeavor to require a customer copay for some projects, particular commercial lighting. When establishing rebate caps for programs that service non-residential customers, it is important to delineate between small businesses and large businesses. “Small Business” is defined as customers with a peak connected load less than 100 kW. Guidelines for incentive caps are as follows:
    - Large C&I:
        - Lighting: 75% of incremental cost
        - Non-lighting: 100% of incremental cost
    - Small Business:
        - Lighting: 90% of incremental cost
        - Non-lighting: 100% of incremental cost

A.5. Simulation Modeling

The savings for some weather sensitive measures were developed via simulation modeling. The model software platforms included are as follows:

- eQuest©;
- BEopt™; and
- EnergyGauge USA®.

A.6. Weather

Various measures in the TRM refer to Typical Meteorological Year version 3 (TMY3) weather data. This data is publicly available from the National Renewable Energy Laboratory (NREL) National Solar Radiation Database (NSRDB).

This data reflects the typical year of New Orleans weather based off historical data, and is the common practice for projecting average annual savings of weather sensitive measures. Inputs from the TMY3 dataset for New Orleans included the following:

- Temperature;
- Humidity;
- Wind speed and direction;
- Cloud cover; and

- Solar radiation.

A.7. Application of Values in this TRM

It is the intent to have the values in this TRM provide parameters to stipulate ex-post gross energy savings (kWh) and demand reduction (kW) estimate. The values in this TRM do not account for free-ridership, as that is a parameter that may vary based on a program delivery mechanism (for example, the free-ridership rates for residential lighting differ significantly between retail markdown in the Consumer Products versus direct install in Green Light New Orleans).

The values in this TRM will be used to verify ex post gross energy savings (kWh) and demand reductions (kW), except when specified otherwise in an EM&V plan.

A.8. Future Studies

Each measure section includes a discussion of future studies suggested by the authors of this TRM. For many measures, no studies are recommended, and suggested updates include only updating when codes and standards affecting the specific measure change. The suggestion of future studies is focused on areas of high impact in the Energy Smart portfolio (such as duct sealing) and for the identification of potential future high impact measures (such as ductless mini-split HVAC systems).

The studies detailed are suggestions on the part of the authors of the TRM and guidance and feedback on these issues is welcomed as part of the stakeholder advisory process.

The general guidelines that are provided for when a study is warranted are as follows (though occasionally subject to modification as specified in a measure-specific chapter):

- Measures should be flagged for further review if they exceed 1% of portfolio savings. In such instances, it should be determined whether:
    - I. Primary data has been collected in Energy Smart evaluations to support the deemed savings;
    - II. The data is sufficiently recent to support its continued use; and
    - III. If data collection to support a deemed savings revision is cost-effective or cost-feasible given the implementation and EM&V budgets for Energy Smart programs.
- Measures that are not over the high-impact threshold should be considered for impact or market assessment studies if:
    - I. Stakeholders (the Council and their Advisors, ENO, implementers, interveners, the EM&V contractor, and/or other appropriate parties)

conclude a measure is of strategic importance to future program implementation efforts; or

II. A measure is high-impact within an important market sub-segment (such as low-income multifamily or municipal government).

A.9. Treatment of Measures Not Included in the TRM

The Energy Smart programs will include measures that are not in the TRM. How these measures are to be treated in the implementation and evaluation process varies situationally:

- Many measures in the commercial and industrial segment are custom measures for which deemed savings are inappropriate. These measures will be validated individually based on IPMVP protocols.
- Direct load control (DLC) or load management (LM) programs curtail peak loads through installation of control devices on specific systems (DLC) or through voluntary self-curtailment (LM). These programs are not appropriate for inclusion in a TRM and should have their performance validated annually.

The TRM will be updated via a two-stage process each year:

- In the first quarter of each calendar year, a technical forum will be held in which stakeholders may suggest measure additions or updates. This will inform the scope of TRM additions and/or updates to be completed that calendar year.
- Based on this scope, the EM&V contractor will develop the updates, and submit these for comment in July. The results of these comments will be discussed in a second technical conference in August, with the TRM updates finalized in September.

There are measures that may be appropriate for the TRM but are not included in Version 1.0. Such measures should be brought forward in the first-quarter technical conference when possible. If a measure is brought forward by program implementers or other stakeholders, the EM&V contractor may work with the appropriate stakeholders in finalizing an *ad hoc* measure whitepaper for use until the measure can be formalized in a TRM update. It is at the discretion of the EM&V contractor to determine if primary data collection is warranted before allowing deemed savings for measures through this whitepaper process.

B.Residential Measures

B.1. Appliances

B.1.1. Energy Star Clothes Washers

B.1.1.1. Measure Description

This measure involves the installation of a residential ENERGY STAR® clothes washer > 2.5 ft^3 in a new construction or replacement-on-burnout application. This measure applies to all residential applications.

B.1.1.2. Baseline and Efficiency Standards[1]

The baseline standard for deriving savings from this measure is the current federal minimum efficiency levels.

The efficiency standard is the ENERGY STAR® requirements for clothes washers.

Efficiency performance for clothes washers are characterized by Integrated Modified Energy Factor (IMEF) and Integrated Water Factor (IWF). The units for IMEF are ft^3/kWh/cycle. Units with higher IMEF values are more efficient. The units for IWF are gallons/cycle/ft^3. Units with lower IWF values will use less water and are therefore more efficient.

Table 2: ENERGY STAR® Clothes Washer – Baseline and Efficiency Levels

Clothes Washer Configuration	***ENERGY STAR® Efficiency Level Effective 3/7/2015***
Top Loading	MEF ≥ 2.06 WF ≤ 4.3
Front Loading	MEF ≥ 2.38 WF ≤ 3.7

1 Current federal standards for clothes washers can be found on the DOE website at: http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/39.

Current ENERGY STAR® criteria for clothes washers can be found on the ENERGY STAR® website at: http://www.energystar.gov/index.cfm?c=clotheswash.pr_crit_clothes_washers.

ENERGY STAR® Most Efficient criteria for clothes washers can be found at: http://www.energystar.gov/ia/partners/downloads/most_efficient/2015/Final_ENERGY_STAR_Most_Efficient_2015_Recognition_Criteria_Clothes_Washers.pdf.

B.1.1.3. Estimated Useful Life (EUL)

The average lifetime of this measure is 14 years, according to the US DOE.[2]

B.1.1.4. Deemed Savings Values

For retrofit situations, baseline and efficiency case energy consumption is based on the configuration of the replaced unit and new unit (top loading or front loading). For new construction applications, a top loading clothes washer is assumed as the baseline and the efficient equipment is either top loading or front loading.

Table 3: ENERGY STAR® Clothes Washer – Deemed Savings

Baseline Configuration	Efficient Configuration	Water Heater Fuel Type	Dryer Fuel Type	kW Savings	kWh Savings	Therms Savings
Top Loading	Top Loading	Gas	Gas	0.005	23	9.9
		Gas	Electric	0.045	192	4.1
		Electric	Gas	0.027	114	5.8
		Electric	Electric	0.067	282	0.0
Top Loading	Front Loading	Gas	Gas	0.009	38	12.4
		Gas	Electric	0.047	198	7.0
		Electric	Gas	0.045	191	5.4
		Electric	Electric	0.083	351	0.0
Front Loading	Front Loading	Gas	Gas	0.002	6	4.1
		Gas	Electric	0.022	93	1.2
		Electric	Gas	0.008	32	3.0
		Electric	Electric	0.028	119	0.0

B.1.1.5. Calculation of Deemed Savings

Energy savings for this measure were derived using the ENERGY STAR® Clothes Washer Savings Calculator.[3] Unless otherwise specified, all savings assumptions are extracted from the ENERGY STAR® calculator. The baseline and ENERGY STAR® efficiency levels are set to those matching Table 2. The ENERGY STAR® calculator

[2] U.S. DOE "Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Clothes Washers" Section 8.2.3 Product Lifetimes. April 2012. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/39.

[3] The ENERGY STAR® Clothes Washer Savings Calculator can be found on the ENERGY STAR® website on the right hand side of the page at:www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=CW.

determines savings based on whether an electric or gas water heater is used. Calculations are also conducted based on whether the dryer is electric or gas.

For applications using an electric water heater and an electric dryer, the savings are calculated as follows:

$$kWh_{savings} = \left(E_{conv,machine} + E_{conv,WH} + E_{conv,dryer}\right) - \left(E_{ES,machine} + E_{ES,WH} + E_{ES,dryer}\right)$$

Where:

$E_{conv,machine}$= Conventional machine energy (kWh)

$E_{conv,WH}$= Conventional water heating energy (kWh)

$E_{conv,dryer}$= Conventional dryer energy (kWh)

$E_{ES,machine}$= ENERGY STAR® machine energy (kWh)

$E_{ES,WH}$= ENERGY STAR® water heating energy (kWh)

$E_{ES,dryer}$=ENERGY STAR® dryer energy (kWh)

B.1.1.5.1. Energy Savings

Energy consumption for the above factors can be determined using the following algorithms.

$$E_{conv,machine} = \frac{MCF \times RUEC_{conv} \times LPY}{RLPY}$$

$$E_{conv,WH} = \frac{WHCF \times RUEC_{conv} \times LPY}{RLPY}$$

$$E_{conv,dryer} = \left(\frac{CAP \times LPY}{IMEF_{FS}} - \frac{RUEC_{conv} \times LPY}{RLPY}\right) \times DUF$$

$$E_{ES,machine} = \frac{MCF \times RUEC_{ES} \times LPY}{RLPY}$$

$$E_{ES,WH} = \frac{WHCF \times RUEC_{ES} \times LPY}{RLPY}$$

$$E_{ES,dryer} = \left(\frac{CAP \times LPY}{IMEF_{ES}} - \frac{RUEC_{ES} \times LPY}{RLPY}\right) \times DUF$$

Where:

MCF= Machine electricity consumption factor = 20%

$WHCF$= Water heating electricity consumption factor = 80%

$RUEC_{conv}$= Rated unit electricity consumption (kWh/year) = 381 (Top Loading); 169 (Front Loading)

$RUEC_{ES}$ = Rated unit electricity consumption (kWh/year) = 230 (Top Loading); 127 (Front Loading)

CAP= Clothes washer capacity = 3.5 (ft^3)

$IMEF_{FS}$= Federal Standard Integrated Modified Energy Factor (ft^3/kWh/cycle)

$IMEF_{ES}$= ENERGY STAR® Integrated Modified Energy Factor (ft^3/kWh/cycle)

LPY = Loads per year = 295

$RLPY$= Reference loads per year = 392

DUF= Dryer use factor = 91%

B.1.1.5.2. Demand Savings

Demand savings are calculated using the following equation:

$$kW_{savings} = \frac{kWh_{savings}}{AOH} \times CF$$

AOH = Annual operating hours = LPY ´ d = 295 hours

CF = Coincidence factor = 0.07[4]

B.1.1.6. Incremental Cost

The incremental cost is $190[5].

[4] Value from Clothes Washer Measure, Mid Atlantic TRM 2014. Metered data from Navigant Consulting "EmPOWER Maryland Draft Final Evaluation Report Evaluation Year 4 (June 1, 2012 – May 31, 2013) Appliance Rebate Program." March 21, 2014, p. 36.

[5] ENERGY STAR Appliance Calculator: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwihkoHI8f3OAhVW5mMKHe72Du4QFggeMAA&url=https%3A%2F%2Fwww.energystar.gov%2Fsites%2Fdefault%2Ffiles%2Fasset%2Fdocument%2Fappliance_calculator.xlsx&usg=AFQjCNFAy5-mu5GR3BjLp4MR1LqrOHegCA&sig2=8l5MGUh1_bJy3lSl9wAWIA

B.1.1.7. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. Thus, savings are calculated using ENERGY STAR default values. If this measure is added to Energy Smart programs, the evaluation should include a review of actual efficiency levels and costs of units purchased by New Orleans residents.

Deemed parameters should be updated whenever DOE standards or other applicable codes warrant it.

B.1.2. ENERGY STAR® Dryers

B.1.2.1. Measure Description

This measure involves the installation of a residential ENERGY STAR® dryers in a new construction or replacement-on-burnout application. This measure applies to all residential applications.

B.1.2.2. Baseline and Efficiency Standards[6]

The baseline standard for deriving savings from this measure is the current federal minimum efficiency levels. The efficiency standard is the ENERGY STAR® requirements for dryers.

ENERGY STAR® Clothes Dryers are more efficient than standard ones and save energy. They have a higher CEF (Combined Energy Factor) and may incorporate a moisture sensor to reduce excessive drying of clothes and prolonged drying cycles. ENERGY STAR® Heat pump dryers or ventless dryers have higher CEF than conventional ENERGY STAR® dryers.

Table 4: ENERGY STAR® Dryer – Baseline and Efficiency Levels[7]

	Vented Gas Dryer	***Ventless or Vented Electric, Standard ≥ 4.4 ft^3***	***Ventless or Vented Electric, Compact (120V) < 4.4 ft^3***	***Vented Electric, Compact (240V) < 4.4 ft^3***	***Ventless Electric, Compact (240V) < 4.4 ft^3***	***Heat Pump Clothes Dryer***
ENERGY STAR® Required CEF	3.48	3.93	3.80	3.45	2.68	7.60
Federal standard CEF	2.84	3.11	3.01	2.73	2.13	3.11
Average load (in lbs.)	8.45	8.45	3.0	3.0	3.0	8.45
Default loads per year	283	283	283	283	283	283
Default capacity (in ft^3)	5.0	5.0	3.0	3.0	3.0	5.0

[6] Current federal standards for clothes dryers can be found on the DOE website at: https://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/36.

Current ENERGY STAR® criteria for clothes dryers can be found on the ENERGY STAR® website at: https://www.energystar.gov/products/appliances/clothes_dryers.

ENERGY STAR® Most Efficient criteria for clothes washers can be found at: http://www.energystar.gov/ia/partners/downloads/most_efficient/2015/Final_ENERGY_STAR_Most_Efficient_2015_Recognition_Criteria_Clothes_Washers.pdf.

[7] The ENERGY STAR® Clothes Dryer Savings Calculator can be found on the ENERGY STAR® website on the right hand side of the page at: www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=CW

B.1.2.3. Estimated Useful Life (EUL)

The average lifetime of this measure is 12 years, according to the US DOE.[8]

B.1.2.4. Deemed Savings Values

For retrofit situations, baseline and efficiency case energy consumption is based on the size of the replaced unit and new unit. For new construction applications.

Table 5: ENERGY STAR® Clothes Dryer – Deemed Savings

Product Type	Energy Savings (kWh/yr.)	Demand Reduction (kW)
Vented Electric, Standard (4.4 ft^3 or greater capacity)	152.42	.0226
Vented Electric, Compact (120V) (less than 4.4 ft^3 capacity)	55.71	.0083
Vented Electric, Compact (240V) < 4.4 ft^3	61.66	.0092
Ventless Electric, Compact (240V) < 4.4 ft^3	77.71	.0115
Heat Pump Clothes Dryer	431.56	.0641

B.1.2.5. Calculation of Deemed Savings

B.1.2.5.1. Energy and Demand Savings

Energy savings for this measure were derived using the ENERGY STAR® Dryer Savings Calculator.[9] Unless otherwise specified, all savings assumptions are extracted from the ENERGY STAR® calculator.

The energy and demand savings are obtained through the following formulas:

$$DkWh/yr = Cycles_{wash} \times \%_{dry/wash} \times Load_{avg} \times \left(\frac{1}{CEF_{base}} - \frac{1}{CEF_{ee}}\right)$$

$$\Delta kW_{peak} = \frac{\left(\frac{1}{CEF_{base}} - \frac{1}{CEF_{ee}}\right) \times Load_{avg}}{time_{cycle}} \times CF$$

Where:

$Cycles_{wash}$ = Number of washing machine cycles per year = 283 cycles/year

[8] U.S. DOE "Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Clothes Dryer" Section 8.2.3 Product Lifetimes. April 2011. https://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/36.

[9] The ENERGY STAR®Clothes Washer Savings Calculator can be found on the ENERGY STAR® website on the right hand side of the page at:www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=CW.

$Load_{avg}$ = Weight of average dryer load, in pounds per load = Standard Dryer: 8.45 lbs/load and Compact Dryer: 3.0 lbs/load[10] [11]

$\%_{dry/wash}$ = Percentage of homes with a dryer that use the dryer every time clothes are washed = 95%

CEF_{base} = Combined Energy Factor of baseline dryer (lbs/kWh) = See Table 14[12]

CEF_{ee} = Combined Energy Factor of ENERGY STAR® dryer (lbs/kWh) = See table 14[13]

$time_{cycle}$ = Duration of average drying cycle in hours = 1 hour

CF - Coincidence Factor = 0.042[14]

B.1.2.6. Incremental Cost

The incremental cost of high efficiency clothes dryers is detailed in Table 6.

[10] Test Loads for Compact and Standard Dryer in Appendix D2 to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Clothes Dryers. http://www.ecfr.gov/cgi-bin/text-idx?SID=9d051184ada3b0d0b5b553f624e0ab05&node=10:3.0.1.4.18.2.9.6.14&rgn=div9

[11] 2011-04 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment. Residential Clothes Dryers and Room Air Conditioners, Chapter 7. Clothes Dryer Frequency from Table 7.3.3 for Electric Standard. http://www.regulations.gov/contentStreamer?objectId=0900006480c8ee11&disposition=attachment&contentType=pdf

[12] Federal Standard for Clothes Dryers, Effective January 1, 2015. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/36

[13] ENERGY STAR® Specification for Clothes Dryers Version 1.0, Effective January 1, 2015. http://www.energystar.gov/products/specs/sites/products/files/ENERGY%20STAR%20Final%20Draft%20Version%201.0%20Clothes%20Dryers%20Specification_0.pdf

[14] 6) Central Maine Power Company. "Residential End-Use Metering Project". 1988. Using 8760 data for electric clothes dryers, calculating the CF according to the PJM peak definition.

Table 6: ENERGY STAR® Clothes Dryer Incremental Costs

Product Type	***Incremental Cost***
Vented Electric, Standard: (4.4 ft^3 or greater capacity)	$40[15]
Vented Electric, Compact (120V): (less than 4.4 ft^3 capacity)	$40
Vented Electric, Compact: (240V) < 4.4 ft^3	$40
Ventless Electric, Compact: (240V) < 4.4 ft^3	$40

B.1.2.7. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. Thus, savings are calculated using ENERGY STAR default values. If this measure is added to Energy Smart programs, the evaluation should include a review of actual efficiency levels and costs of units purchased by New Orleans residents.

Deemed parameters should be updated whenever DOE standards or other applicable codes warrant it.

[15] ENERGY STAR Appliance Calculator: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwihkoHI8f3OAhVW5mMKHe72Du4QFggeMAA&url=https%3A%2F%2Fwww.energystar.gov%2Fsites%2Fdefault%2Ffiles%2Fasset%2Fdocument%2Fappliance_calculator.xlsx&usg=AFQjCNFAy5-mu5GR3BjLp4MR1LqrOHegCA&sig2=8l5MGUh1_bJy3lSl9wAWIA

B.1.3. ENERGY STAR® Dishwashers

B.1.3.1. Measure Description

This measure involves the installation of an ENERGY STAR® dishwasher in a new construction or replacement-on-burnout situation. This measure applies to all residential applications.

B.1.3.2. Baseline and Efficiency Standards

The baseline for this measure is the current federal standard as displayed in the table below.

Table 7: ENERGY STAR® Criteria for Dishwashers[16]

	ENERGY STAR® Criteria		
	Capacity	***Annual Energy Consumption (AEC) kWh/Year***	***Gallons/Cycle***
Standard Model Size (Effective Until 1/26/2016)	> 8 place settings + 6 serving pieces	< 295	< 4.25
Standard Model Size (Effective On 1/26/2016)[17]	> 8 place settings + 6 serving pieces	AECbase + AECadderconnected AECbase: 270 AECadderconnected: 0.05 × AECbase	< 3.5
Compact Model Size (Effective On 1/26/2016)	< 8 place settings + 6 serving pieces	< 203	< 3.1

B.1.3.3. Estimated Useful Life (EUL)

The average lifetime of this measure is 15 years, according to the US DOE.[18]

B.1.3.4. Deemed Savings Values

Deemed savings are per installed unit based on the water heating fuel type.

Table 8: ENERGY STAR® Dishwashers – Deemed Savings Values

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[16] ENERGY STAR® criteria for dishwashers can be found on the ENERGY STAR® website at: www.energystar.gov/index.cfm?c=dishwash.pr_crit_dishwashers.

[17] ENERGY STAR® efficiency requirements as of January 26, 2016 are defined on their website at www.energystar.gov/sites/default/files/ENERGY%20STAR%20Residential%20Dishwasher%20Version%206.0%20Final%20Program%20Requirements_0.pdf.

[18] U.S. DOE, Technical Support Document: "Energy Efficiency Program for Consumer Products and Commercial Industrial Equipment: Residential Dishwashers, Section 8.2.3 Product Lifetimes." May 2012. http://www.regulations.gov/#!documentDetail;D=EERE-2011-BT-STD-0060-0007.

Download TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2011-BT-STD-0060-0007.

	Water Heater Fuel Type	kW Savings	kWh Savings	Therms Savings
Standard Model Size	Gas	0.0005	5	0.3
Standard Model Size	Electric	0.0011	12	0.0

B.1.3.5. Calculation of Deemed Savings

B.1.3.5.1. Energy Savings

Energy savings for this measure were derived using the ENERGY STAR® Dishwasher Savings Calculator.[19] The baseline and ENERGY STAR® efficiency levels are set to those matching Table 7 and Table 8.

$$kWh_{Savings} = \left(E_{conv,machine} + E_{conv,WH}\right) - \left(E_{ES,machine} + E_{ES,WH}\right)$$

Where:

$E_{conv,machine}$= Conventional machine energy (kWh)

$E_{conv,WH}$= Conventional water heating energy (kWh)

$E_{ES,machine}$= ENERGY STAR® machine energy (kWh)

$E_{ES,WH}$= ENERGY STAR® water heating energy (kWh)

Algorithms to calculate the above parameters are defined as:

$$E_{conv,machine} = MCF \times RUEC_{conv}$$

$$E_{conv,WH} = WHCF \times RUEC_{conv}$$

$$E_{ES,machine} = MCF \times RUEC_{ES}$$

$$E_{ES,WH} = WHCF \times RUEC_{ES}$$

B.1.3.5.2. Demand Savings

Demand savings can be derived using the following:

$$kW_{Savings} = \frac{kWh_{Savings}}{AOH} \times CF$$

Where:

MCF= Machine electricity consumption factor = 44%

[19] The ENERGY STAR® Dishwasher Savings Calculator, updated January 20, 2012, can be found on the ENERGY STAR® website.

$WHCF$= Water heating electricity consumption factor = 56%

$RUEC_{conv}$= Rated unit electricity consumption = 307 (kWh/year)

$RUEC_{ES}$ = Rated unit electricity consumption = 295 (kWh/year)

CPY = Cycles per year = 215

d = Average wash cycle duration = 2.1 hours[20]

AOH = Annual operating hours = CPY ´ d = 451.5 hours

CF = Coincidence factor = 0.036[21]

$\eta_{gas\ WH}$= Gas water heater efficiency = 75%

B.1.3.6. Incremental cost

The incremental cost of ENERGY STAR© Dishwashers is $10[22].

B.1.3.7. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. Thus, savings are calculated using ENERGY STAR default values. If this measure is added to Energy Smart programs, the evaluation should include a review of actual efficiency levels and costs of units purchased by New Orleans residents.

Deemed parameters should be updated whenever DOE standards or other applicable codes warrant it.

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[20] Average of Consumer Reports Cycle Times for Dishwashers. http://www.consumerreports.org/cro/dishwashers.htm. Information available for subscribers only.

[21] Hendron, R. & Engebrecht, C. 2010, , National Renewable Energy Laboratory (NREL). "Building America Research Benchmark Definition: Updated December" US U.S. DOE. January 2010. p. 14 (peak hour of 4 PM was applied). http://www.nrel.gov/docs/fy10osti/47246.pdf

[22] ENERGY STAR Appliance Calculator: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwihkoHI8f3OAhVW5mMKHe72Du4QFggeMAA&url=https%3A%2F%2Fwww.energystar.gov%2Fsites%2Fdefault%2Ffiles%2Fasset%2Fdocument%2Fappliance_calculator.xlsx&usg=AFQjCNFAy5-mu5GR3BjLp4MR1LqrOHegCA&sig2=8l5MGUh1_bJy3lSl9wAWIA

B.1.4. ENERGY STAR® Refrigerators

B.1.4.1. Measure Description

This measure involves replace-on-burnout or early retirement of an existing refrigerator and installation of a new, full-size (7.75 ft^3 or greater) ENERGY STAR® refrigerator. This measure applies to all residential or small commercial applications.

To qualify for early retirement, the ENERGY STAR® unit must replace an existing, full-size, working unit that is at least six years old. For early retirement, the maximum lifetime age of an eligible piece of equipment is capped at the point at which it is expected that 75 percent of the equipment has failed. Where the age of the unit exceeds the 75 percent failure age, ROB savings should be applied. This cap prevents early retirement savings from being applied to projects where the age of the equipment greatly exceeds the estimated useful life of the measure.

B.1.4.2. Baseline and Efficiency Standards[23]

For ROB, the baseline for refrigerators is the DOE minimum efficiency standards for refrigerators, effective September 15, 2014.

For an individual refrigerator early retirement program, the baseline for refrigerators is assumed to be the annual unit energy consumption of the refrigerator being replaced, as reported by the Association of Home Appliance Manufacturers (AHAM) refrigerator database24, adjusted for age according to the formula in the Measure Savings Calculations section. AHAM energy use data includes the average manufacturer-reported annual kilowatt hour usage, by year of production. This data dates back to the 1970s.

Alternatively, the baseline annual kilowatt hour usage of the refrigerator being replaced may be estimated by metering for a period of at least three hours using the measurement protocol specified in the US DOE report, "*Incorporating Refrigerator Replacement into the Weatherization Assistance Program*."[25]

To determine annual kWh of the refrigerator being replaced, use the formula:

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[23] Current federal standards for refrigerators can be found on the DOE website at: http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/43. Current ENERGY STAR® criteria for refrigerators can be found on the ENERGY STAR® website at: www.energystar.gov/index.cfm?c=refrig.pr_crit_refrigerators

[24] AHAM Refrigerator Database. http://rfdirectory.aham.org/AdvancedSearch.aspx

[25] Moore, A. 2001, D&R International, Ltd. *"Incorporating Refrigerator Replacement into the Weatherization Assistance Program: Information Tool Kit."* U.S. DOE. November 19. http://www.waptac.org/data/files/website_docs/training/standardized_curricula/curricula_resources/refrigerator_info_toolkit.pdf

$$kWh/yr = \frac{WH \times 8{,}760}{h \times 1{,}000}$$

Where:

WH = the watt-hours metered during a time period

h = measurement time period (hours)

8,760 = hours in a year

1,000 watt-hours = 1 kWh

For the early retirement application, all new refrigerators must replace refrigerators currently in use, and all replaced refrigerators must be dismantled in an environmentally-safe manner in accordance with applicable federal, state, and local regulations. The installer will provide documentation of proper disposal of refrigerators.

Newly-installed refrigerators must meet current ENERGY STAR® efficiency levels. All newly-installed refrigerators must be connected to an adequately-sized electrical receptacle and be grounded in accordance to the National Electric Code (NEC).

Minimum efficiency requirements for ENERGY STAR® refrigerators are set at 10% more efficient than required by the minimum federal government standard. The standard varies depending on the size and configuration of the refrigerator. See Table 9.

Configuration Codes (Table 9):

BF: Bottom Freezer

SD: Refrigerator Only – Single Door

SR: Refrigerator/Freezer – Single Door

SS: Side-by-Side

TF: Top Freezer

TTD: Through the Door (Ice Maker)

A: Automatic Defrost

M: Manual Defrost

P: Partial Automatic Defrost

AV[26] = Adjusted Volume

Table 9: Formulas to Calculate the ENERGY STAR® Refrigerator Criteria[27]

Product Category	**Federal Standard as of Sept 15, 2014 Standard (kWh/year)**	**Maximum ENERGY STAR® Energy Usage (kWh/year)[28]**	**Ice (Y/N)**	**Defrost**	**Average Adjusted Volume[29]**	**kWh**	**kW**
Refrigerator-only—manual defrost	6.79 × AV + 193.6	6.111 × AV + 174.24	Y, N	M	20.8	33.48	0.00772
Refrigerator-freezers—manual or partial automatic defrost	7.99 × AV + 225.0	7.191 × AV + 202.5	Y, N	M, P	24.51	42.08	0.00970
Refrigerator-only—automatic defrost	7.07 × AV + 201.6	6.363 × AV + 181.44	Y, N	A	15.75	31.30	0.00721
Built-in refrigerator-only—automatic defrost	8.02 × AV + 228.5	7.218 × AV + 205.65	Y, N	A	16.97	36.46	0.00840
Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker	8.85 × AV + 317.0	7.965 × AV + 285.3	N	A	18.36	47.95	0.01105
Built-in refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker	9.40 × AV + 336.9	8.46 × AV + 378.81	N	A	17.57	58.43	0.01347
Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker without TTD ice service	8.85 × AV + 401.0	7.965 × AV + 360.9	N	A	24.6	61.87	0.01426

[26] Adjusted Volume (AV) can be found for ENERGY STAR® certified refrigerators on their website under the "advanced view" option. https://data.energystar.gov/Active-Specifications/ENERGY-STAR-Certified-Residential-Refrigerators/p5st-her9. Scroll to the right until you reach the column named "Adjusted Volume".

[27] Available for download at http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/43.

[28] Ten percent more efficient than baseline, as specified in the ENERGY STAR® appliance calculator.

[29] This is the average volume of Energy Star qualified units for each configuration, based on the dataset located at: https://data.energystar.gov/Active-Specifications/ENERGY-STAR-Certified-Residential-Refrigerators/p5st-her9/data

Product Category	Federal Standard as of Sept 15, 2014 Standard (kWh/year)	Maximum ENERGY STAR® Energy Usage (kWh/year)[28]	Ice (Y/N)	Defrost	Average Adjusted Volume[29]	kWh	kW
Built-in refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker without TTD ice service	9.40 × AV + 420.9	8.46 × AV + 378.81	N	A	21.67	43.03	0.00992
Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker with TTD ice service	9.25 × AV + 475.4	8.325× AV + 427.86	Y	A	32.34	77.45	0.01785
Built-in refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker with TTD ice service	9.83 × AV + 499.9	8.847 × AV + 449.91	Y	A	21.67	71.29	0.01643
Refrigerator-freezers—automatic defrost with side-mounted freezer without an automatic icemaker	8.51 × AV + 297.8	7.659 × AV + 268.02	N	A	30.44	55.68	0.01283
Built-in refrigerator-freezers—automatic defrost with side-mounted freezer without an automatic icemaker	10.22 × AV + 357.4	9.198 × AV + 321.66	N	A	33.71	36.76	0.00847
Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker without TTD ice service	8.51 × AV + 381.8	7.659 × AV + 343.62	N	A	30.44	39.03	0.00900
Built-in refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker without TTD ice service	10.22 × AV + 441.4	9.198 × AV + 397.26	N	A	34.06	78.95	0.01820

Product Category	***Federal Standard as of Sept 15, 2014 Standard (kWh/year)***	***Maximum ENERGY STAR® Energy Usage (kWh/year)[28]***	***Ice (Y/N)***	***Defrost***	***Average Adjusted Volume[29]***	***kWh***	***kW***
Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker with TTD ice service	8.54 × AV + 432.8	7.686 × AV + 389.52	Y	A	33.06	71.51	0.01648
Built-in refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker with TTD ice service	10.25 × AV + 502.6	9.225 × AV + 452.34	Y	A	33.6	84.70	0.01952
Refrigerator freezers—automatic defrost with top-mounted freezer without an automatic icemaker	8.07 × AV + 233.7	7.263 × AV + 210.33	N	A	17.8	37.73	0.00870
Built-in refrigerator-freezers—automatic defrost with top-mounted freezer without an automatic icemaker	9.15 × AV + 264.9	8.235 × AV + 238.41	N	A	17.8	27.41	0.00632
Refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic ice maker without TTD ice service	8.07 × AV + 317.7	7.263 × AV + 285.93	N	A	21.22	62.26	0.01435
Built-in refrigerator-freezers—automatic defrost with top-mounted freezer without an automatic ice maker with TTD ice service	9.15 × AV + 348.9	8.235 × AV + 238.41	N	A	21.22	129.91	0.02994
Refrigerator-freezers—automatic defrost with top-mounted freezer with TTD ice service	8.40 × AV + 385.4	7.56 × AV + 346.86	Y	A	21.22	56.36	0.01299

B.1.4.3. Estimated Useful Life (EUL)

According to the Department of Energy Technical Support Document,[30] the Estimated Useful Life of High Efficiency Refrigerators is 17 years.

B.1.4.4. Measure Savings Calculations

Deemed peak demand and annual energy savings should be calculated as shown below. Note that these savings calculations are different depending on whether the measure is replace-on-burnout or early retirement.

B.1.4.4.1. Energy Savings

B.1.4.4.1.1. Replace-on-Burnout

$$kWh_{savings} = kWh_{baseline} - kWh_{ES}$$

Where:

$kWh_{baseline}$ = Federal standard baseline average energy usage (Table 9)

kWh_{ES}= ENERGY STAR® average energy usage (Table 9)

B.1.4.4.1.2. Early Retirement

Annual kWh and kW savings must be calculated separately for two time periods:

The estimated remaining life of the equipment that is being removed, designated the remaining useful life (RUL), and

The remaining time in the EUL period (17 – RUL)

For the RUL (Table 10):

$$kWh_{savings} = kWh_{pre} - kWh_{ES}$$

kWh_{pre} refers to manufacturer data or a measured consumption that is adjusted using applicable degradation factors.

$$kWh_{pre} = kWh_{manf} \times (1 + \text{PDF})^{n}\ x\ SLF$$

For the remaining time in the EUL period:

Calculate annual savings as you would for a replace-on-burnout project using the equation below. Lifetime kWh savings for Early Retirement Projects is calculated as follows:

[30] U.S. DOE 2011, Technical Support Document: "Residential Refrigerators, Refrigerator-Freezers, and Freezers, 8.2.3 Product Lifetimes." September 15. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/43.

Download TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2008-BT-STD-0012-0128.

$$Lifetime\ kWh_{savings} = \left(kwh_{savings,ER} \times RUL\right) + \left[kWh_{savings,ROB} \times (EUL - RUL)\right]$$

Where:

kWh_{NAECA}= NAECA baseline average energy usage (Table 9)

kWhpre = Adjusted manufacturer energy usage

kWh_{ES} = ENERGY STAR® average energy usage (Table 9)

kWh_{manf} = annual unit energy consumption from the Association of Home Appliance Manufacturers (AHAM) refrigerator database[31]

PDF = Performance Degradation Factor 0.0125/year. Refrigerator energy use is expected to increase at a rate of 1.25% per year as performance degrades over time[32]

n = age of replaced refrigerator (years)

SLF = Site/Lab Factor = 0.81 to account for the difference between DOE laboratory testing and actual conditions[33]

RUL = Remaining Useful Life (Table 10)

EUL = Estimated Useful Life = 17 years

B.1.4.4.2. Demand Savings

Since refrigerators operate 24/7, average kW reduction is equal to annual kWh divided by 8,760 hours per year. As shown below, this average kW reduction is multiplied by temperature and load shape adjustment factors to derive peak period kW reduction.

$$kW_{savings} = \frac{kWh_{savings}}{8{,}760\ hrs} \times \text{TAF} \times \text{LSAF}$$

Where:

TAF = Temperature Adjustment Factor[34] = 1.188

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[31] AHAM Refrigerator Database. http://rfdirectory.aham.org/AdvancedSearch.aspx.

[32] 2009 Second Refrigerator Recycling Program NV Energy – Northern Nevada Program Year 2009; M&V, ADM, Feb 2010, referencing Cadmus data on a California program, February 2010.

[33] Peterson, J, et. al., 2007, "Gross Savings Estimation for Appliance Recycling Programs: The Lab Versus In Situ Measurement Imbroglio and Related Issues" International Energy Program Evaluation Conference (IEPEC). Cadmus, et. al. "Residential Retrofit High Impact Measure Evaluation Report." February 8, 2010.

[34] Proctor Engineering Group, Michael Blasnik & Associates, and Conservation Services Group, 2004, *"Measurement & Verification of Residential Refrigerator Energy Use: Final Report – 2003-2004 Metering Study"*. July 29. Factor to adjust for varying temperature based on site conditions, p. 47.

LSAF = Load Shape Adjustment Factor[35] = 1.074

[35] Proctor Engineering Group, Michael Blasnik & Associates, and Conservation Services Group, 2004, "Measurement & Verification of Residential Refrigerator Energy Use: Final Report – 2003-2004 Metering Study". July 29. Used load shape adjustment for "hot days" during the 4PM hour, pp. 45-48.

B.1.4.4.3. *Derivation of RULs*

ENERGY STAR® Refrigerators have an estimated useful life of 17 years. This estimate is consistent with the age at which 50 percent of the refrigerators installed in a given year will no longer be in service, as described by the survival function in Figure 1.

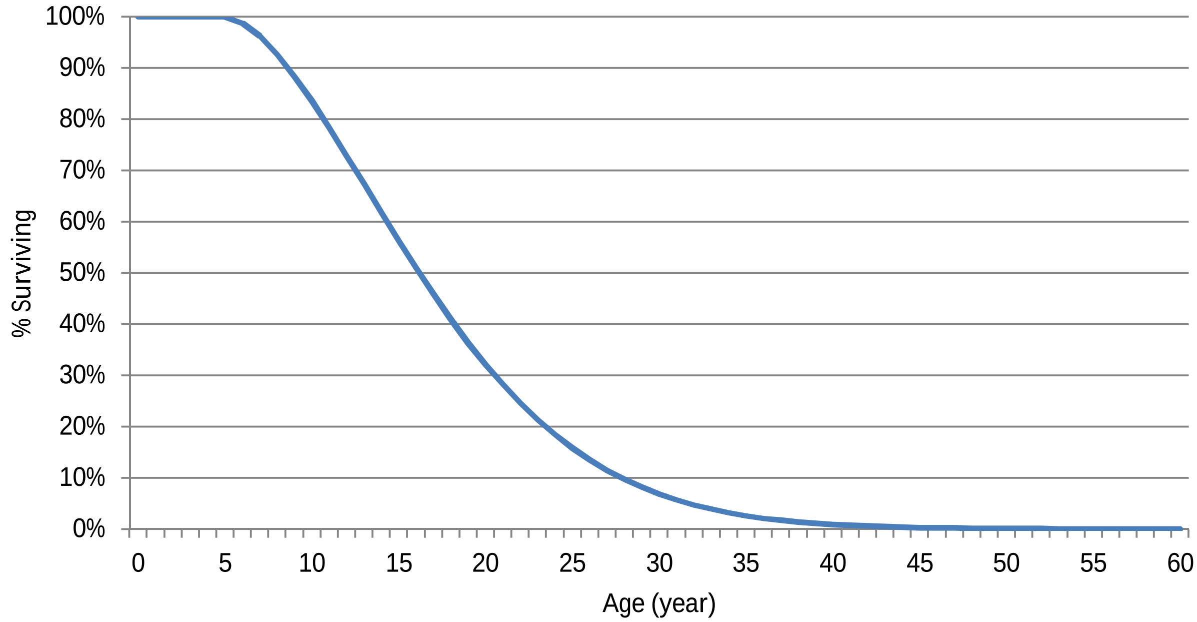

Figure 1: Survival Function for ENERGY STAR® Refrigerators[36]

The method for estimating the RUL of a replaced system uses the age of the existing system to re-estimate the projected unit lifetime based on the survival function shown in Figure 1. The age of the refrigerator being replaced is found on the horizontal axis, and the corresponding percentage of surviving refrigerators is determined from the chart. The surviving percentage value is then divided in half, creating a new estimated useful lifetime applicable to the current unit age. The age (year) that corresponds to this new percentage is read from the chart. RUL is estimated as the difference between that age and the current age of the system being replaced.

Table 10: Remaining Useful Life (RUL) of Replaced Refrigerator[37]

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[36] U.S. DOE, Technical Support Document, 2011, "Residential Refrigerators, Refrigerator-Freezers, and Freezers, 8.2.3 Product Lifetimes." September 15.
http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/43.

Download TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2008-BT-STD-0012-0128.

Age of Replaced Refrigerator (years)	*RUL (years)*	*Age of Replaced Refrigerator (years)*	*RUL (years)*
6	10.3	15	6.0
7	9.6	16	5.8
8	8.9	17	5.5
9	8.3	18	5.3
10	7.8	19	5.1
11	7.4	20	4.9
12	7.0	21	4.8
13	6.6	22	4.6
14	6.3	23 +	0.0

B.1.4.5. Incremental Cost

The incremental cost for efficient refrigerators is $40[38] for ENERGY STAR units and $140[39] for CEE Tier II units.

For early retirement, incremental cost is calculated using:

1) Full installed cost of the refrigerator: program-actual purchase price should be used. If not available, use $451 for ENERGY STAR and $551 for CEE Tier 2 units[40].
2) Present value of replacement cost of a baseline refrigerator after the RUL of the initial replaced unit is exhausted. This unit costs $411[41] at the time of purchase, and should be discounted by the number of years of RUL. If RUL is unknown,

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[37] Use of the early retirement baseline is capped at 22 years, representing the age at which 75 percent of existing equipment is expected to have failed. Equipment older than 22 years should use the ROB baseline.

[38] From ENERGY STAR appliance calculator

[39] Based on weighted average of units participating in Efficiency Vermont program and retail cost data provided in Department of Energy, "TECHNICAL REPORT: Analysis of Amended Energy Conservation Standards for Residential Refrigerator-Freezers", October 2005; http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/refrigerator_report_1.pdf

[40] Based on weighted average of units participating in Efficiency Vermont program and retail cost data provided in Department of Energy, "TECHNICAL REPORT: Analysis of Amended Energy Conservation Standards for Residential Refrigerator-Freezers", October 2005; http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/refrigerator_report_1.pdf

[41] Calculated by subtracting $40 incremental cost for ENERGY STAR refrigerators off of full purchase price of $451.

use 4 years. Default discount rate is 10%[42]. This results in a deferred replacement cost of $281.

3) Overall incremental cost of early retirement is then calculated as:
    a. ENERGY STAR: $451 - $281 = $70
    b. CEE Tier II: $170

B.1.4.6. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. Thus, savings are calculated using ENERGY STAR default values. If this measure is added to Energy Smart programs, the evaluation should include a review of actual efficiency levels and costs of units purchased by New Orleans residents.

Deemed parameters should be updated whenever DOE standards or other applicable codes warrant it.

[42] "Participant Discount Rate" recommended in CA Standard Practice Manual.

B.1.5. Advanced Power Strips

B.1.5.1. Measure Description

This measure involves the installation of a multi-plug Advanced Power Strip (APS, also known as "Smart Strips") that has the ability to automatically disconnect specific loads depending on the power draw of a specified or "master" load.

There are two categories of smart strips:

1) **Tier 1:** Tier 1 advanced power strips have a master controls socket arrangement and will shut off items plugged into the controlled power-saver sockets when the sense that the appliance plugged into the master socket has been turned off. The power-saving functions of the control sockets is not used when the master appliance is turned on.
2) **Tier 2:** Tier 2 advanced power strips manage both active and standby consumption. Tier 2 smart strips manage standby power consumption by turning off devices from a control event; this could be a TV or other item powering off, which then powers off the controlled outlets to save energy. Active power consumption is managed by monitoring a user's engagement or presence in a room either by infrared remote signals or motion sensing. After a period of inactivity, the Tier 2 unit will shut off controlled outlets.

B.1.5.2. Expected Useful Life

For Tier 1 advanced power strips, the EUL is 10 years[43].

For Tier 2 advanced power strips, there has not been a study performed to validate EUL. Until better data is available, they should default to using the current EUL of Tier 1 devices.

B.1.5.3. Baseline & Efficiency Standard

The baseline case is the absence of an APS, where peripherals are plugged in to a traditional surge protector or wall outlet.

The efficiency standard case is the presence of an APS, with all peripherals plugged into the APS.

[43] New York State Energy Research and Development Authority (NYSERDA) 2011, *Advanced Power Strip Research Report*, p. 30. August.

B.1.5.1. Deemed Savings Values

Table 11: Deemed Savings for Residential APS

Tier	Size	Usage	kW Savings	kWh Savings
1	5-plug	Unspecified	.0056	48.9
		Entertainment	.0077	62.1
		Computer	.0037	35.8
	7-plug	Unspecified	.0067	57.7
		Entertainment	.0092	74.5
		Computer	.0045	42.9
2	5-plug	Unspecified	.0194	204.2
		Entertainment	.0316	307.4
		Computer	.0172	100.9

B.1.5.2. Estimated Useful Life (EUL)

The measure life is 10 years according to the NYSERDA Advanced Power Strip Research Report from August 2011.[44]

B.1.5.3. Calculation of Deemed Savings

Energy and demand savings for a 5-plug APS in use in a home office or for a home entertainment system are calculated using the following algorithm, where kWh saved are calculated and summed for all peripheral devices:

Tier 1:

$$DkWh/yr_{\text{unspecified use}} = \frac{(kW_{comp\ idle} \times HOU_{comp\ idle}) + (kW_{TVidle} \times HOU_{TV\ idle})}{2} \times 365\frac{\boldsymbol{days}}{\boldsymbol{yr}} \times ISR = 48.9\ kWh\ (5\text{-plug});\ 57.7\ kWh\ (7\text{-plug})$$

$$DkWh/yr_{\text{entertainment center}} = kW_{TV\ idle} \times HOU_{TV\ idle} \times 365\frac{days}{yr} \times ISR = 62.1\ kWh\ (5\text{-plug});\ 74.5\ kWh\ (7\text{-plug})$$

$$DkWh/yr_{\text{computer}} = kW_{Comp\ idle} \times HOU_{Comp\ idle} \times 365\frac{days}{yr} \times ISR = 35.8\ kWh\ (5\text{-plug});\ 42.9\ (7\text{-plug})$$

44 New York State Energy Research and Development Authority (NYSERDA) 2011, *Advanced Power Strip Research Report*, p. 30. August.

DkW_{peak} *unspecified use* $= \frac{CF \times (kW_{comp\ idle} + kW_{TV\ idle})}{2} \times ISR$ =0.0056 kW (5-plug); 0.0067 kW (7-plug)

DkW_{peak} *entertainment center* $= CF \times kW_{TV\ idle} \times ISR$ =0.0077 kW (5-plug); 0.0092 kW (7-plug)

DkW_{peak} *Computer* $= CF \times kW_{Comp\ idle} \times ISR$ =0.0037 kW (5-plug); 0.0045 kW (7-plug)

Tier 2 Smart Strip:

DkWh unspecified use $= \frac{(kWh_{comp} + kWh_{TV})}{2} \times ESF \times ISR = 204.2\ kWh$

DkWh entertainment center $= kWh_{TV} \times ESF \times ISR = 307.4\ kWh$

DkWh Computer $= kWh_{Comp} \times ESF \times ISR = 100.9\ kWh$

DkW_{peak} *unspecified use* $= \frac{CF \times (\Delta kWh_{comp} + \Delta kWh_{entertainment})}{2 \times 8760\ \frac{hours}{yr}} \times ISR$ =0.0194 kW

DkW_{peak} *entertainment center* $= \frac{CF \times \Delta kWh_{entertainment}}{8760\ \frac{hours}{yr}} \times ISR = 0.0316\ kW$

DkW_{peak} *Computer* $= \frac{CF \times \Delta kWh_{computer}}{8760\ \frac{hours}{yr}} \times ISR = 0.0172\ kW$

Table 12: APS Assumptions

Parameter	Unit	Value	Source
kWcomp idle, Idle kW of computer system	kW	.0049 (5-plug) .00588 (7-plug)	45, 46, 47
HOUcomp idle, Daily hours of computer idle time	Hours/day	20	45
kWTV idle, Idle kW of TV system	kW	. 0085 (5-plug) .00102 (7-plug)	45, 47
HOUTV idle, Daily hours of TV idle time	Hours/day	20	45
kWhTV, Annual kWh of TV system	kWh	602.8	47
kWhcomp, Annual kWh of computer system	kWh	197.9	47
ISR, In-Service-Rate	%	1.0	
CF, Coincidence Factor	%	Entertainment Center = .90 Computer System= .763 Unspecified = .832	48
ESF, Energy Savings Factor. Percent of baseline energy consumption saved by installing the measure	%	Entertainment Center = .51	49

B.1.5.4. Incremental Cost

The incremental cost for APS systems is as follows:

Tier (1) – 5-plug: $16[50]

Tier (1) – 7-plug: $26[51]

Tier (2): $65[52]

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[45] "Electricity Savings Opportunities for Home Electronics and Other Plug-In Devices in Minnesota Homes", Energy Center of Wisconsin, May 2010.

[46] "Smart Plug Strips", ECOS, July 2009.

[47] "Advanced Power Strip Research Report", NYSERDA, August 2011"

[48] C F Values of Standby Losses for Entertainment Center and Home Office in Efficiency Vermont TRM, 2013, pg 16. Developed through negotiations between Efficiency Vermont and the Vermont Department of Public Service

[49] "Tier 2 Advanced Power Strip Evaluation for Energy Saving Incentive," California Plug Load Research Center, 2014. http://www.efi.org/docs/studies/calplug_tier2.pdf

[50] Price survey performed in NYSERDA Measure Characterization for Advanced Power Strips, p4

[51] Ibid

[52] California Technology Forum, June 2015: https://static1.squarespace.com/static/53c96e16e4b003bdba4f4fee/t/556e25a3e4b06957271187a1/1433281955286/2015-01-15+Tier+2+Advance+Power+Strip+Cal+TF+Workpaper+Presentation_January.pdf

B.1.5.5. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure had exceedingly low participation in Energy Smart programs (a total of 336 kWh in PY6). As a result, savings are calculated using values cited from evaluation reports completed on behalf of the New York State Energy Research & Development Authority (NYSERDA) and Wisconsin Focus On Energy. If participation reached 1% of residential Energy Smart program savings, the evaluation should include fieldwork to support in-service rates and to document an inventory of the equipment actually installed in to the APS by New Orleans residents.

B.1.6. ENERGY STAR® Ceiling Fans

B.1.6.1. Measure Description

ENERGY STAR® ceiling fans require a more efficient CFM/Watt rating at the low, medium, and high settings than standard ceiling fans as well ENERGY STAR® qualified lighting for those with light kits included. Both of these features save energy compared to standard ceiling fans.

B.1.6.2. Estimated Useful Life (EUL)

The measure life for ceiling fans is 20 years.[53]

B.1.6.3. Deemed Savings

Deemed savings are calculated for fan-only ceiling fans.

Table 13: ENERGY STAR® Ceiling Fan – Deemed Savings

Fan Type	Energy Savings (kWh)	Demand Reduction (kW)
ENERGY STAR Lighting	68.9	.0087
Fan Only	16.0	0.00132

B.1.6.4. Calculation of Deemed Savings

B.1.6.4.1. Energy Savings - Fan

The energy savings are obtained through the following formula:

$$\Delta kWh = \left[\left(\%_{low} \times (Low_{base} - Low_{ee})\right) + \left(\%_{med} \times (Med_{base} - Med_{ee})\right) + \left(\%_{high} \times (High_{base} - High_{ee})\right)\right] \times \frac{1\,kW}{1000\,W} \times HOU_{fan} \times 365\,\frac{days}{yr}$$

Where:

$\%_{low}$ = percentage of low setting use = 40%[54]

$\%_{med}$ = percentage of medium setting use = 40%[54]

$\%_{high}$ = percentage of high setting use = 20%[54]

Low_{base} = Wattage of low setting, baseline (W) = 15W[54]

Med_{base} = Wattage of medium setting, baseline (W) = 34W[54]

$High_{base}$ = Wattage of high setting, baseline (W) = 67W[54]

Low_{ee} = Wattage of low setting, ENERGY STAR® (W) = 4.8W[55,56]

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[53] Residential and C&I Lighting and HVAC Report Prepared for SPWG, 2007. Pg C-2.

[54] ENERGY STAR® Lighting Fixture and Ceiling Fan Calculator. Updated September, 2013

Med_{ee} = Wattage of medium setting, ENERGY STAR® (W) = 18.2W[55,56]

$High_{ee}$ = Wattage of high setting, ENERGY STAR® (W) = 45.9W[55,56]

HOU_{fan} = fan daily hours of use (hours/day) = 3 hours/day[54]

B.1.6.4.2. Energy Savings – Lighting

The energy savings from lighting apply the deemed savings assumptions specified in the Residential Lighting chapter of this TRM. The assumed configuration is (3) 14W CFLs, applying a 43W baseline. Other inputs may be applied by program implementers if model-specific information is available.

B.1.6.4.3. Demand Savings – Lighting

Demand savings are calculated in accordance with protocols specified in the Residential Lighting chapter.

B.1.6.4.4. Demand Savings - Fans

Demand savings result from the lower connected load of the ENERGY STAR® fan and ENERGY STAR® lighting. Peak demand savings are estimated using a Coincidence Factor (CF).

$$\Delta kW = \left[\left(\%_{low} \times (Low_{base} - Low_{ee})\right) + \left(\%_{med} \times (Med_{base} - Med_{ee})\right) + \left(\%_{high} \times (High_{base} - High_{ee})\right)\right] \times \frac{1\,kW}{1000\,W} \times CF$$

Where:

CF = Demand Factor= 0.091[57]

B.1.6.5. Incremental Cost

The incremental cost of a three-lamp ENERGY STAR Ceiling Fan is $46[58].

B.1.6.6. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using ENERGY STAR default values. If this measure is added to Energy Smart programs, the

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[55] ENERGY STAR® Ceiling Requirements Version 3.0

[56] ENERGY STAR® Certified Ceiling Fan List, Accessed April 3, 2014.

[57] EmPOWER Maryland 2012 Final Evaluation Report: Residential Lighting Program, Prepared by Navigant Consulting and the Cadmus Group, Inc., March 2013, Table 50.

[58] ENERGY STAR® Lighting Fixture and Ceiling Fan Calculator. Updated September, 2013

evaluation should include a review of the models actually incented through the program. The key parameters to be examined include:

- Content of the lighting included with the fan;
- Rated wattage of the fans at low, medium, and high speeds.

Deemed parameters should be updated whenever DOE standards or other applicable codes warrant it.

B.1.7. ENERGY STAR® Dehumidifiers

B.1.7.1. Measure Description

ENERGY STAR® must meet the minimum qualifying efficiency standard established by the current ENERGY STAR Version 3.0.

B.1.7.2. Baseline & Efficiency Standard

Table 14 shows the federal standard minimum efficiency and ENERGY STAR® standards, effective October 1, 2012. Federal standards do not limit residential dehumidifier capacity, but since ENERGY STAR® standards do limit the capacity to 185 pints per day, Table 14 only presents standards for the range of dehumidifier capacities that savings can be claimed.

Table 14: Dehumidifier Federal and ENERGY STAR® Efficiency Standards

Capacity (pints/day)	Federal Standard (L/kWh_{base})	ENERGY STAR® (L/kWh_{ee})
≤ 35	1.35	≥ 1.85
> 35 ≤ 45	1.50	
>45 ≤ 54	1.60	
>54 < 75	1.70	
75 ≤ 185	2.5	≥ 2.80

B.1.7.3. Estimated Useful Life (EUL)

The measure life for dehumidifiers is 12 years[59]

B.1.7.4. Deemed Savings

Deemed savings are calculated for ENERGY STAR units over the federal minimum standards for each capacity range.

Table 15: Dehumidifier Default Energy Savings[60]

[59] EnergyStar Calculator Accessed July 2013 using ENERGY STAR® Appliances. February 2008. U.S. Environmental Protection Agency and U.S. Department of Energy. ENERGY STAR® . http://www.energystar.gov/.

Capacity Range (pints/day)	Default Capacity (pints/day)	Federal Standard (kWh/yr)	ENERGY STAR (kWh/yr)	ΔkWh/yr	ΔkW_{peak}
≤ 35	35	834	609	225	0.05584
> 35 ≤ 45	45	965	782	183	0.04541
>45 ≤ 54	54	1086	939	147	0.03648
>54 < 75	74	1,400	1,287	113	0.02804
75 ≤ 185	130	1,673	1,493	180	0.04467

B.1.7.5. Calculation of Deemed Savings

The general form of the equation for the ENERGY STAR® Dehumidifier measure savings algorithm is:

$$DkWh/yr_{total} = Number\ of\ Dehumidifiers \times Savings\ per\ Dehumidifier$$

To determine resource savings, the per-unit estimates in the algorithms will be multiplied by the number of dehumidifiers. The number of dehumidifiers will be determined using market assessments and market tracking.

B.1.7.5.1. Energy Savings

Per unit energy and demand savings algorithms:

$$\Delta\,kWh/yr = \left(\frac{CAPY \times 0.437\frac{liters}{pint}}{24\frac{hours}{day}}\right) \times HOU \times \left(\frac{1}{L/kWh_{base}} - \frac{1}{L/kWh_{ee}}\right)$$

Where:

$CAPY$ = Average capacity of the unit (pints/day)

HOU = Annual hours of operation (hours/yr), 1,632[61]

L/kWh_{base} = Baseline unit liters of water per kWh consumed (liters/kWh). See Table 14.

L/kWh_{ee} = ENERGY STAR® qualified unit liters of water per kWh consumed (liters/kWh). See Table 14.

[60] Derived from equations in section 2.4.8, matching values generated by Energy Star Appliance Savings Calculator: http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/appliance_calculator.xlsx

[61] ENERGY STAR® Appliance Savings Calculator. Updated August, 2013. This may not accurately reflect New Orleans humidity and can be revised if this measure is a sizable contributor to Energy Smart energy savings.

B.1.7.5.2. *Demand Savings*

$$\Delta kW_{peak} = \frac{\Delta\, kWh/yr}{HOU} \times CF$$

Where:

CF = Demand Factor 0.405[62]

B.1.7.6. Incremental Cost

The incremental cost for an ENERGY STAR Dehumidifier is $60[63].

B.1.7.7. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using ENERGY STAR default values. If this measure is added to Energy Smart programs, the evaluation should include a review of the units actually installed, adjusting savings based on capacity and efficiency levels.

If the measure exceeds 1% of residential kWh savings, a metering study should be completed to validate usage assumptions.

Deemed parameters should be updated whenever DOE standards or other applicable codes warrant it.

[62] Dehumidifier Metering in PA and Ohio by ADM from 7/17/2013 to 9/22/2013. 31 Units metered. Assumes all non-coincident peaks occur within window and that the average load during this window is representative of the June PJM days as well.

[63] ENERGY STAR® Appliance Savings Calculator

B.1.8. ENERGY STAR® Pool Pumps

B.1.8.1. Measure Description

This measure involves the replacement of a single-speed pool pump with an ENERGY STAR® certified variable speed or multi-speed pool pump. This measure applies to all residential applications; however, pools that serve multiple tenants in a common area are not eligible for this measure.

Multi-speed pool pumps are an alternative to variable speed pumps. The multi-speed pump uses an induction motor that is basically two motors in one, with full-speed and half-speed options. Multi-speed pumps may enable significant energy savings. However, if the half-speed motor is unable to complete the required water circulation task, the larger motor will operate exclusively. Having only two speed-choices limits the ability of the pump motor to fine-tune the flow rates required for maximum energy savings.[64] Therefore, multi-speed pumps must have a minimum size of 1 horsepower (HP) to be eligible for this measure.

B.1.8.2. Baseline and Efficiency Standards

The baseline condition is a 0.5-3 horsepower (HP) standard efficiency single-speed pool pump.

The high efficiency condition is a 0.5-3 HP ENERGY STAR® certified variable speed or multi-speed pool pump.

B.1.8.3. Estimated Useful Life (EUL)

According to DEER 2014, the estimated useful life for this measure is 10 years.[65]

B.1.8.4. Deemed Savings Values

Deemed savings are per installed unit based on the pump horsepower.

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[64] Hunt, A. & Easley, S., 2012, "*Measure Guideline: Replacing Single-Speed Pool Pumps with Variable Speed Pumps for Energy Savings."* Building America Retrofit Alliance (BARA), U.S. U.S. DOE. May/. http://www.nrel.gov/docs/fy12osti/54242.pdf.

[65] Database for Energy Efficient Resources (2014). http://www.deeresources.com/.

Table 16: Variable Speed Pool Pumps – Deemed Savings Values

Pump HP	kW Savings	kWh Savings
0.5	0.24	1,713
0.75	0.28	1,860
1	0.36	2,063
1.5	0.47	2,465
2	0.52	2,718
2.5	0.57	2,838
3	0.72	3,364

Table 17: Multi-Speed Pool Pumps – Deemed Savings Values

Pump HP	kW Savings	kWh Savings
1	0.30	1,629
1.5	0.40	1,945
2	0.41	1,994
2.5	0.46	2,086
3	0.54	2,292

B.1.8.5. Calculation of Deemed Savings

B.1.8.5.1. Energy Savings

Energy savings for this measure were derived using the ENERGY STAR® Pool Pump Savings Calculator.[66]

$$kWh_{Savings} = kWh_{conv} - kWh_{ES}$$

Where:

kWh_{conv}= Conventional single-speed pool pump energy (kWh)

kWh_{ES}= ENERGY STAR® variable speed pool pump energy (kWh)

Algorithms to calculate the above parameters are defined as:

$$kWh_{conv} = \frac{PFR_{conv} \times 60 \times hours_{conv} \times days}{EF_{conv} \times 1000}$$

[66] The ENERGY STAR® Pool Pump Savings Calculator, updated February 2013, can be found on the ENERGY STAR® website at: https://www.energystar.gov/products/certified-products/detail/pool-pumps.

$$hours_{conv} = \frac{V_{pool} \times PT}{PFR_{conv} \times 60}$$

$$kWh_{ES} = kWh_{HS} + kWh_{LS}$$

$$kWh_{HS} = \frac{PFR_{HS} \times 60 \times hours_{HS} \times days}{EF_{HS} \times 1000}$$

$$kWh_{LS} = \frac{PFR_{LS} \times 60 \times hours_{LS} \times days}{EF_{LS} \times 1000}$$

$$PFR_{LS} = \frac{V_{pool}}{t_{turnover} \times 60}$$

Where:

kWh_{HS} = ENERGY STAR® variable speed pool pump energy at high speed (kWh)

kWh_{LS} = ENERGY STAR® variable speed pool pump energy at low speed (kWh)

$hours_{conv}$ = Conventional single-speed pump daily operating hours (Table 18)

$hours_{HS,VS}$ = ENERGY STAR® variable speed pump high speed daily operating hours = 2 hours

$hours_{LS,VS}$ = ENERGY STAR® variable speed pump low speed daily operating hours = 10 hours

$hours_{HS,MS}$ = ENERGY STAR® multi-speed pump high speed daily operating hours = 2 hours

$hours_{LS,VS}$ = ENERGY STAR® multi-speed pump low speed daily operating hours (Table 19)

$days$ = Operating days per year = 7 months x 30.4 days/month = 212.8 days (default)

PFR_{conv} = Conventional single-speed pump flow rate (gal/min) (Table 18)

$PFR_{HS,VS}$ = ENERGY STAR® variable speed pump high speed flow rate = 50 gal/min (default)

$PFR_{LS,VS}$ = ENERGY STAR® variable speed pump low speed flow rate (gal/min) = 30.6 (default)

$PFR_{HS,MS}$ = ENERGY STAR® multi-speed pump high speed flow rate (gal/min) (Table 19)

$PFR_{LS,MS}$ = ENERGY STAR® multi-speed pump low speed flow rate (gal/min) (Table 19)

EF_{conv} = Conventional single-speed pump energy factor (gal/W·hr) (Table 18)

$EF_{HS,VS}$ = ENERGY STAR® variable speed pump high speed energy factor = 3.75 gal/W·hr (default)

$EF_{LS,VS}$ = ENERGY STAR® variable speed pump low speed energy factor = 7.26 gal/W·hr (default)

$EF_{HS,MS}$ = ENERGY STAR® multi-speed pump high speed energy factor (gal/W·hr) (Table 19)

$EF_{LS,MS}$ = ENERGY STAR® multi-speed pump low speed energy factor (gal/W·hr) (Table 19)

V_{pool} = Pool volume = 22,000 gal (default)

PT = Pool turnovers per day = 1.5 (default)

$t_{turnover,VS}$ = Variable speed pump time to complete 1 turnover = 12 hours (default)

$t_{turnover,MS}$ = Multi-speed pump time to complete 1 turnover (Table 19)

60 = Constant to convert between minutes and hours

1000 = Constant to convert W to kW

Table 18: Conventional Pool Pumps Assumptions

Pump HP	***hours$_{conv}$***	***PFR$_{conv}$ (gal/min)***	***EF$_{conv}$ (gal/W·h)***
0.5	11.0	50.0	2.71
0.75	10.4	53.0	2.57
1	9.2	60.1	2.40
1.5	8.6	64.4	2.09
2	8.5	65.4	1.95
2.5	8.1	68.4	1.88
3	7.5	73.1	1.65

Table 19: ENERGY STAR® Multi-Speed Pool Pumps Assumptions

Pump HP	$t_{,turnover,M}S$	$hours_{MS,LS}$	$PFR_{HS,MS}$ (gal/min)	$EF_{HS,MS}$ (gal/W·h)	$PFR_{LS,MS}$ (gal/min)	$EF_{LS,MS}$ (gal/W·h)
1	11.8	9.8	56.0	2.40	31.0	5.41
1.5	11.5	9.5	61.0	2.27	31.9	5.43
2	11.0	9.0	66.4	1.95	33.3	5.22
2.5	10.8	8.8	66.0	2.02	34.0	4.80
3	9.9	7.9	74.0	1.62	37.0	4.76

B.1.8.5.2. Demand Savings

Demand savings can be derived using the following:

$$kW_{Savings} = \left[\frac{kWh_{conv}}{hours_{conv}} - \left(\frac{kWh_{HS} + kWh_{LS}}{hours_{HS} + hours_{LS}}\right)\right] \times \frac{CF}{days}$$

Where:

CF = Coincidence factor[67] = 0.31

B.1.8.6. Incremental Cost

The incremental cost for ENERGY STAR Pool Pumps is[68]:

- $549 for Variable Speed
- $235 for Multi-Speed

B.1.8.7. Future Studies

This measure has low-to-moderate participation in Energy Smart programs. In PY6, pool pump savings totaled 19,157 kWh. If measure savings reach a minimum of 500,000 kWh in a program year, ADM recommends a metering study to validate usage assumptions.

Deemed parameters should be updated whenever DOE standard s or other applicable codes warrant it.

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[67] Southern California Edison (SCE) Design & Engineering Services, 2008., *"Pool Pump Demand Response Potential, DR 07.01 Report."* June 2008. Derived from Table 16 assuming a peak period of 2-6 PM.

[68] ENERGY STAR Pool Pump Calculator

B.2. Domestic Hot Water

B.2.1. Water Heater Replacement

B.2.1.1. Measure Description

This measure involves:

- The replacement of electric water heaters by heat pump water heaters (HPWH)
- The replacement of either electric or gas water heaters by ENERGY STAR® certified solar water heaters

Electric resistant storage tank water heaters do not qualify as the code update effective April 16, 2015 requires a minimum of 95% efficiency for this equipment category.

Heat Pump Water Heaters and Solar Water Heaters are eligible for systems that are no larger than 55 gallons.

Water heating deemed savings values are measured on an annual per-unit basis. Deemed savings variables include tank volume, estimated water usage, weather zone, and rated energy factor. Fuel substitution is not eligible for deemed savings. This measure applies to all residential applications.

B.2.1.2. Baseline and Efficiency Standards

The current baseline for electric and gas water heaters is the US DOE energy efficiency standard (10 CFR Part 430), which is consistent with the International Energy Conservation Code (IECC) 2009. April 16, 2015 must comply with the amended standards found in the Code of Federal Regulations, 10 CFR 430.32(d), as found in Table 20.

Table 20: Title 10: 430.32 (d) Water Heater Standards and their Compliance Dates

Product class	***Energy factor as of April 16, 2015***
Gas-fired Water Heater (≥ 20 gal and ≤ 100 gal)	For Vs ≤ 55 gallons: EF = 0.675−(0.0015 × Vs) For Vs > 55 gallons: EF = 0.8012−(0.00078 × Vs).
Electric Water Heater (≥ 20 gal and ≤120 gal)	For Vs ≤ 55 gallons: EF = 0.960−(0.0003 × Vs). For Vs > 55 gallons: EF = 2.057−(0.00113 × Vs).
Where Vs is the Rated Storage Volume which equals the water storage capacity of a water heater, in gallons, as certified by the manufacturer.	

Current baseline Energy Factors (efficiencies) for standard size electric and gas water heaters are calculated and shown in Table 21. Future baseline Energy Factors (efficiencies) to be used after 2015 for standard size electric water heaters are calculated and shown in Table 22.

Table 21: Water Heater Replacement Baseline Energy Factors (Pre-2015)

Minimum Required Energy Factors by NAECA for Electric Resistance Heating Before 4/16/2015			
Tank Size (Gallons) of Replaced Water			
40	***50***	***65***	***80***
0.92	0.90	0.88	0.86

The Energy Factor of a replacement water heater must be at least 5 percent higher than the baseline for the corresponding fuel type and tank size shown in Table 21 and Table 22.

Table 22: Water Heater Replacement Baseline Energy Factors (2015)

Minimum Required Energy Factors by NAECA for Electric Resistance Heating After 4/16/2015[69]					
Fuel Type	***Tank Size (Gallons) of Replaced Water Heating***				
	30	***40***	***50***	***65***	***80***
Natural Gas or Propane	0.63	0.62	0.60	0.75	0.74
Electric	0.951	0.948	0.945	1.98	1.97

B.2.1.3. Estimated Useful Life (EUL)

The average lifetime of this measure is dependent on the type of water heating. According to DEER 2014, the following measure lifetimes should be applied:

- 10 years for Heat Pump Water Heaters
- 15 years for solar water heaters

B.2.1.4. Deemed Savings

Table 23: Deemed kWh Savings for Water Heater Replacement

[69] 10 CFR Part 430.32 Energy Conservation Program for Consumer Products: Energy Conservation Standards for Water Heaters; Final Rule. www.gpo.gov/fdsys/pkg/CFR-2012-title10-vol3/pdf/CFR-2012-title10-vol3-sec430-32.pdf

Water Heater System Type	HVAC System Type	Capacity (Gallons)				
		30	40	50	65	80
Heat Pump Water heater	Gas Furnace	943	1,239	1,415	361	440
	Heat Pump	1,132	1,489	1,700	433	529
	Electric Resistance	1,580	2,076	2,371	604	738
	Unconditioned Space	1,654	2,175	2,483	582	712
Solar With Electric backup	N/A	1,395	1,832	2,089	1,048	1,265

Table 24: Deemed kW Savings for Water Heater Replacement

Water Heater System Type	HVAC System Type	Capacity (Gallons)				
		30	40	50	65	80
Heat Pump Water heater	Gas Furnace	0.0827	0.1087	0.1241	0.0317	0.0386
	Heat Pump	0.0993	0.1306	0.1491	0.0380	0.0464
	Electric Resistance	0.1386	0.1821	0.2079	0.0530	0.0647
	Unconditioned Space	0.1451	0.1907	0.2178	0.0510	0.0624
Solar With Electric backup	N/A	0.1223	0.1607	0.1832	0.0919	0.1109

B.2.1.5. Calculation of Deemed Savings – Heat Pump Water Heater (HPWH)

B.2.1.5.1. Energy Savings – Heat Pump Water Heater

The residential heat pump water heater (HPWH) measure involves the installation of an integrated ENERGY STAR® HPWH. The HPWHs available through the ENERGY STAR® product finder[70] have an average EF of 2.75.

The variables affecting deemed savings are: storage tank volume, HPWH Energy Factor (EF), HPWH installation location (in conditioned or unconditioned space), and weather zone. This measure takes into account an air-conditioning energy savings ("Cooling Bonus") and an additional space heating energy requirement ("Heating Penalty") associated with the HPWH when it is installed inside conditioned space.

$$kWh_{Savings} = \frac{\rho \times C_p \times V \times (T_{SetPoint} - T_{Supply}) \times \left(\frac{1}{EF_{pre}} - \left(\frac{1}{(EF_{post} \times (1 + PA\%)} \times Adj\right)\right)}{3{,}412\ Btu/kWh}$$

Where:

ρ = Water density = 8.33 lb/gal

C_p = Specific heat of water = 1 BTU/lb·°F

V = Estimated annual hot water use (gal) from Table 25

$T_{SetPoint}$ = Water heater set point (value = 122.24°F, based on on-site testing of New Orleans homes)

T_{Supply} = Average New Orleans area supply water temperature, 74.8°F

EF_{pre} = Baseline Energy Factor from Table 21 or Table 22.

EF_{post} = Energy Factor of new HPWH. Energy Star default is 2.75

$PA\%$ = Performance Adjustment to adjust the HPWH EF relative to ambient air temperature per DOE guidance[71] = $0.00008 \times T_{amb}^3 + 0.0011 \times T_{amb}^2 - 0.4833 \times$

[70] www.energystar.gov/productfinder/product/certified-water-heaters/ accessed on 6/27/2015.

[71] Kelso, J. 2003. Incorporating Water Heater Replacement into The Weatherization Assistance Program, May. D&R International, Ltd. Information Tool Kit.

T_{amb} + 0.0857. Assumed conditioned space, 73.4 degrees[72], PA% = 2.17%. For unconditioned space, 68.78 degrees[73], PA% = -1.92%

T_{amb}= Ambient temperature dependent on location of HPWH (Conditioned or Unconditioned Space) and Weather Zone from Table 26

Adj =HPWH-specific adjustment factor to account for Cooling Bonus and Heating Penalty on an annual basis, as well as backup electrical resistance heating which is estimated at 0.92 EF. Adjustment factors are listed in Table 27.

$Conversion\ Factor$ = 3,412 Btu/kWh

Table 25: Estimated Annual Hot Water Use (gal)

Tank Size (gal) of Replaced Water Heater	30	40	50	65	80
Estimated annual hot water usage	12,761	16,696	18,973	22,767	27,320

The average air ambient temperatures listed in Table 26 are applicable to the installation locations for the HPWH. Unconditioned space is considered to be an unheated garage-like environment. This data is based on local ambient temperatures for each weather zone calculated from TMY3 weather data. The conditioned space temperatures assume thermostat settings of 78F (cooling season) and 70F (heating season), and a “balance point temperature”74 of 65F. Unconditioned space ambient temperatures are adjusted from the local temperatures by seasonal factors75 to account for a garage-like setting.

Table 26: Average Ambient Temperatures by Installation Location

Conditioned Space	Unconditioned Space
74.02	68.789

Table 27: HPWH Adjustment[76]

Water Heater	Furnace Type	Adjustment

[72] Average daily outside temperature at which a building maintains a comfortable indoor temperature without heating or cooling”; www.weatherdatadepot.com/faq#.USPZwKWvN8E

[73] From NREL TMY3 database

[74] “Average daily outside temperature at which a building maintains a comfortable indoor temperature without heating or cooling”; www.weatherdatadepot.com/faq#.USPZwKWvN8E

[75] ASHRAE: Standard 152-2004 Table 6.1b and 6.2b

[76] In order to facilitate an algorithmic approach: a spreadsheet model was created which modeled savings accounting for Cooling Bonus and Heating Penalty on an annual basis, as well as backup electrical resistance heating; HPWH Adjustment factors were derived to equate the results of this more extensive model to a simpler algorithm.

Location		Factor
Conditioned Space	Gas	0.917
	Heat Pump	1.201
	Elec. Resistance	1.395
Unconditioned Space	N/A	1.07

As an example, the following deemed electricity savings are applicable for the replacement of a 50-gallon electric storage tank water heater with a 50-gallon heat pump water heater using a model with an EF of 2.75 in conditioned space for a household using a gas furnace in New Orleans:

$$kWh_{Savings} = \frac{8.33 \times 1 \times 18{,}973 \times (122.24 - 74.8) \times \left(\frac{1}{0.90} - \left(\frac{1}{2.75 \times (1 + 0.02173548)} \times .917\right)\right)}{3{,}412}$$

$$= 1{,}383.66\ kWh$$

B.2.1.5.2. Demand Savings – HPWH

$$kW_{savings} = kWh_{savings} \times Ratio_{Annual\ kWh}^{Peak\ kW}$$

Where:

$Ratio_{Annual\ kWh}^{Peak\ kW}$ = 0.0000877

Demand savings were calculated using the US DOE's "*Building America Performance Analysis Procedures for Existing Homes*" combined domestic hot water use profile.[77] Based on this profile, the ratio of Peak kW to Annual kWh for domestic hot water usage was estimated to be 0.0000877 kW per annual kWh savings

For the HPWH example shown in equation above, peak demand savings is 1,383.66 kWh × 0.0000877 = 0.1213 kW.

B.2.1.6. Calculation of Deemed Savings – Solar Water Heating with Gas or Electric Backup

B.2.1.6.1. Energy Savings – Solar Water Heating Systems with Electric Backup

The residential solar water heater measure involves the installation of an ENERGY STAR® certified solar water heater rated by the Solar Rating and Certification

[77] U.S. DOE "Building America Performance Analysis Procedures for Existing Homes" combined domestic hot water use profile.

Corporation (SRCC). Solar water heaters available through the ENERGY STAR® product finder[78] have an average Solar Energy Factor (SEF) of 8.7 for electric backup and 1.9 for gas backup.

The variables affecting deemed savings are: SEF and weather zone.

The SRCC determines SEF based on standardized 1,500 Btu/ft2-day solar radiation profile across the U.S. As solar insolation varies widely depending on geographic location, in order to derive more accurate estimates for a given locale, Localization Factors (LF) are used to adjust the SEF. The LF for the New Orleans weather zone have been calculated. The LF is based on the daily total insolation (1,598 in New Orleans), averaged annually, per a Satellite Solar Radiation model developed by the State University of New York (SUNY).

$$kWh_{Savings} = \frac{\rho \times C_p \times V \times (T_{SetPoint} - T_{Supply}) \times \left(\frac{1}{EF_{pre}} - \frac{1}{SEF\ x\ LF}\right)}{3412\ Btu/kWh}$$

Where:

ρ = Water density = 8.33 lb/gal

C_p = Specific heat of water = 1 BTU/lb·°F

V = Estimated annual hot water use (gal) from Table 25

$T_{SetPoint}$ = Water heater set point (default value = 122.24°F)

T_{Supply} = Average New Orleans area supply water temperature, 74.8°F

EF_{pre} = Baseline Energy Factor

SEF = Solar Energy Factor of new water heater, default of 8.7

LF = Localization Factor for SEF of new water heater in New Orleans, 1.068

As an example, the following deemed electricity savings are applicable for replacement of a 50-gallon electric storage tank water heater with a 50-gallon solar water heater with electric backup using a model with an EF of 8.7 for a household in New Orleans:

$$kWh_{Savings} = \frac{8.33 \times 1 \times 18{,}973 \times (122.24 - 74.8) \times \left(\frac{1}{0.945} - \frac{1}{(8.7\ \times\ 1.068)}\right)}{3{,}412\ Btu/kWh}$$

$$= 2{,}088.8\ kWh/yr$$

[78] www.energystar.gov/productfinder/product/certified-water-heaters/results

B.2.1.6.2. Demand Savings – Solar Water Heating Systems with Electric Backup

$$kW_{savings} = kWh_{savings} \times Ratio\frac{Peak\ kW}{Annual\ kWh}$$

Where:

$Ratio\frac{Peak\ kW}{Annual\ kWh}$ = 0.0000877

For the above example, peak demand savings is 2,088.8 kWh x 0.0000877 = 0.1831 kW.

B.2.1.7. Incremental Cost

The incremental cost of a HPWH is $1,027[79].

The incremental cost of a Solar Water Heater is $8,401[80].

B.2.1.8. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using ENERGY STAR default values. If this measure is added to Energy Smart programs, the evaluation should include a review of actual efficiency levels and costs of units purchased by New Orleans residents.

If participation reached 1% of residential Energy Smart program savings, ADM recommends a metering study to support usage assumptions.

If the measure is under consideration for inclusion or increased emphasis in Energy Smart, ADM recommends a market assessment to provide guidance as to the needs of New Orleans residents and plumbing contractors and to address savings potential.

Deemed parameters should be updated whenever DOE standards or other applicable codes warrant.

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[79] Northeast Energy Efficiency Partnership: Incremental cost Study Phase 3 Final Report. http://www.neep.org/file/1003/download?token=Z0RB3yrZ

[80] California Solar Thermal Program: 2012 reported project costs.

B.2.2. Water Heater Jackets

B.2.2.1. Measure Description

This measure involves water heater jackets (WHJ) installed on water heaters located in an unconditioned space. These estimates apply to all weather regions. This measure applies to all residential applications.

B.2.2.2. Baseline and Efficiency Standards

Baseline is assumed to be the post-1991, storage-type water heater.

WHJ must be installed on storage water heaters having a capacity of 30 gallons or greater. The manufacturer's instructions on the WHJ and the water heater itself should be followed. If electric, thermostat and heating element access panels must be left uncovered. If gas, follow WHJ installation instructions regarding combustion air and flue access.

Table 28: Water Heater Jackets – Baseline and Efficiency Standards

Baseline	***Efficiency Standard***
Un-insulated water heater	Minimum insulation of R-6.7

B.2.2.3. Estimated Useful Life (EUL)

The average lifetime of this measure is 13 years, according to NEAT v.8.6.

B.2.2.4. Deemed Savings Values

Deemed savings are per installed jacket based on the jacket thickness, the type of water heating and the tank size.

Table 29: Water Heater Jackets – Electric Heating Deemed Savings Values

	Electric Water Heating					
Approximate Tank Size (gal)	***kWh Savings***			***kW Savings***		
	40	***52***	***80***	***40***	***52***	***80***
2" WHJ savings kWh	68	76	101	0.005	0.006	0.008
3" WHJ savings kWh	94	104	139	0.007	0.008	0.011

B.2.2.5. Calculation of Deemed Savings

Energy consumption for baseline units, with and without insulation jackets, was calculated using industry-standard energy-use calculation methodologies for residential domestic water heating. Variables in the calculations include the following:

- Water heater fuel type (electric or gas/propane)
- Baseline EF

- Estimated U-value of baseline unit
- Ambient temperature
- Tank volume
- Tank surface area
- Tank temperature
- Estimated hot water consumption

To estimate peak energy consumption, a load profile for residential water heating was developed from individual load profiles for the following end-uses:

- Clothes washer
- Dishwasher
- Faucet
- Shower
- Sink-filling
- Bath
- Miscellaneous

This end-use load shape data was calibrated using metered end-used data obtained from several utility end-use metering studies.

B.2.2.6. Incremental Cost

The incremental cost of a Water Heater Jacket is equal to the full installed cost. If the cost is unknown, use $35[81].

B.2.2.7. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using default values based on NEAT v.8.6 estimates.

In the PY7 or PY8 evaluation of the Home Performance with Energy Star program, it is recommended that the percent of unjacketed water heaters is documented in order to inform whether water heater jackets warrant inclusion as a direct install measure.

[81] Based on review of available products for 40 and 50-gallon water heaters..

B.2.3. Water Heater Pipe Insulation

B.2.3.1. Measure Description

This measure requires water heater pipe insulation. Water heaters plumbed with heat traps are not eligible to receive incentives for this measure. New construction and water heater retrofits are not eligible for this measure, because they must meet current code requirements. This measure applies to all residential applications.

B.2.3.2. Baseline and Efficiency Standards

Baseline is assumed to be the typical gas or electric water heater with no heat.

All hot and cold vertical lengths of pipe should be insulated, plus the initial length of horizontal hot and cold water pipe, up to three feet from the transition, or until wall penetration, whichever is less.

Table 30: Water Heater Pipe Insulation – Baseline and Efficiency Standards

Baseline	Efficiency Standard
Un-insulated hot water pipes	Minimum insulation thickness of ½”

B.2.3.3. Estimated Useful Life (EUL)

The average lifetime of this measure is dependent on the type of water heater it is applied to. According to DEER 2014, the following measure lifetimes should be applied:

- 13 years for electric storage water heating
- 11 years for gas storage water heating
- 10 years for heat pump water heaters

B.2.3.4. Deemed Savings Values

The deemed savings per linear foot are detailed below.

Table 31: Pipe Wrap – Deemed Savings Per Linear Foot

R-value	Pipe Diameter	kWh	kW
3	½”	25.32	.0029
	¾”	37.99	.0043

B.2.3.5. Calculation of Deemed Savings

B.2.3.5.1. Energy Savings – Water Heater Pipe Insulation for Electric, Gas, or Heat Pump Water Heater (HPWH)

$$Annual\ Energy\ Savings = (U_{pre} - U_{post}) \times A \times (T_{Pipe} - T_{ambient}) \times \left(\frac{1}{RE}\right) \times \frac{Hours_{Total}}{Conversion\ Factor}$$

Where:

U_{pre}= 1/(2.03[82]) = 0.49 BTU/h sq. ft. degree F

U_{post}= 1/(2.03+$R_{Insulation}$)

$R_{Insulation}$= R-value of installed insulation

A = Surface area in square feet (πDL) with L (length) and D pipe diameter in feet

T_{Pipe}(°F) = Average temperature of the pipe. Default value = 90 °F (average temperature of pipe between water heater and the wall)

$T_{ambient}$(°F) = 68.78°F (New Orleans)

RE = Recovery Efficiency (or in the case of HPWH, EF); if unknown, use 0.98 as a default for electric resistance water heaters, 0.79 for natural gas water heaters, or 2.2 for heat pump water heaters[83]

$Hours_{Total}$ = 8,760 hr per year[84,85]

$Conversion\ Factor$ = 3,412 Btu/kWh for electric water heating or 100,000 Btu/Therm for gas water heating.

B.2.3.5.2. Demand Savings

Peak demand savings for hot water heaters installed in conditioned space can be calculated using the following formula for electric:

$$kW_{savings} = (U_{pre} - U_{post}) \times A \times (T_{Pipe} - T_{ambientMAX}) \times \left(\frac{1}{RE}\right) \times \frac{1}{3{,}412\ Btu/kWh}$$

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82 2.03 is the R-value representing the film coefficients between water and the inside of the pipe and between the surface and air. Mark's Standard Handbook for Mechanical Engineers, 8th edition.

83 Default values based on median recovery efficiency of residential water heaters by fuel type in the AHRI database, at https://www.ahridirectory.org/ahridirectory/pages/rwh/defaultSearch.aspx

84 Ontario Energy's Measures and Assumptions for Demand Side Management (DSM) Planning www.ontarioenergyboard.ca/OEB/_Documents/EB-2008-0346/Navigant_Appendix_C_substantiation_sheet_20090429.pdf

85 New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs Residential, Multi-Family, and Commercial/Industrial Measures http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/06f2fee55575bd8a852576e4006f9af7/$FILE/TechManualNYRevised10-15-10.pdf

Where:

U_{pre} = 1/(2.03) =0.49 BTU/h sq ft degree F

U_{post} = 1/(2.03+$R_{Insulation}$)

$R_{Insulation}$ = R-value of installed insulation

A = Surface area in square feet (πDL) with L (length) and D pipe diameter in feet

T_{Pipe}(°F) = Average temperature of the pipe. Default value = 90 °F (average temperature of pipe between water heater and the wall)

$T_{ambientMAX}$(°F) =For water heaters installed in unconditioned basements, use an average ambient temperature of 75°F; for water heaters inside the thermal envelope, use an average ambient temperature of 78 °F

RE = Recovery efficiency (or in the case of HPWH, EF); if unknown, use 0.98 as a default for electric resistance or 2.2 for heat pump water heaters.

B.2.3.6. Incremental Cost

The incremental cost of a Water Heater Pipe Insulation is equal to the full installed cost. If the cost is unknown, use $3 per linear foot of insulation[86].

B.2.3.7. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using default values based on NEAT v.8.6 estimates.

In the PY7 or PY8 evaluation of the Home Performance with Energy Star program, it is recommended that the percent of uninsulated hot water lines is documented in order to inform whether pipe insulation warrant inclusion as a direct install measure

[86] California DEER 2014

B.2.4. Faucet Aerators

B.2.4.1. Measure Description

This measure involves retrofitting aerators on kitchen and bathroom water faucets. The savings values are per faucet aerator installed. It is not a requirement that all faucets in a home be treated for the deemed savings to be applicable. This measure applies to all residential applications.

B.2.4.2. Baseline and Efficiency Standards

The 2.2 GPM baseline faucet flow rate[87] is based upon the Energy Policy Act of 1992 (EPAct 92) and subsequent EPAct actions which limited faucet flows to 2.2 GPM. The US EPA WaterSense® specification for faucet aerators is 1.5 gallons per minute (GPM).[88]

Table 32: Faucet Aerators – Baseline and Efficiency Standards

Baseline	Efficiency Standard
2.2 GPM	1.5 GPM maximum

The deemed savings values are for residential, retrofit-only installation of kitchen and bathroom faucet aerators.

B.2.4.3. Additional Requirement for Contractor-Installed Aerators

Aerators that have been defaced so as to make the flow rating illegible are not eligible for replacement. For direct install programs, all aerators removed shall be collected by the contractor and held for possible inspection by the utility until all inspections for invoiced installations have been completed.

B.2.4.4. Estimated Useful Life (EUL)

The average lifetime of this measure is 10 years, according to DEER 2014.

B.2.4.1. Deemed Savings

Table 32 summarizes the deemed kWh and kW for 1.5 GPM and 1.0 GPM faucet aerators, based on the algorithms in the subsections to follow.

Table 33: Faucet Aerators – Deemed Savings

Efficient GPM Rating	kWh	kW
1.5 GPM	26.53	.0028

[87] Maximum flow rate federal standard for lavatories and aerators set in Federal Energy Policy Act of 1992 and codified at 2.2 GPM at 60 psi in 10CFR430.32

[88] "High-Efficiency Lavatory Faucet Specification." WaterSense. EPA. October 1, 2007. http://www.epa.gov/watersense/partners/faucets_final.html

1.0 GPM	44.22	.0046

B.2.4.2. Effect of Weather Zones on Water Usage and Water Main Temperature

Average water main temperatures for the New Orleans is 74.8°F. The water main temperature data was approximated using the following formula.[89]

$$T\ of\ water\ main = T_{avg\ ambient} + R \times \Delta T_{amb}$$

Where:

$T_{avg\ ambient}$ = the average annual ambient dry bulb temperature, 68.8°F in New Orleans

R = 0.05

ΔT_{amb} = the average of maximum and minimum ambient air dry bulb temperature for the month (Tmax + Tmin)/2 where Tmax = maximum ambient dry bulb temperature for the month, and Tmin = minimum ambient dry bulb temperature for the month

Baseline and efficiency-standard water usages per capita were derived from an analysis of metered studies of residential water efficiency retrofit projects conducted for Seattle, WA.; the East Bay Municipal Utility District (CA); and Tampa, FL.[90, 91, 92]

B.2.4.3. Estimated Hot Water Usage Reduction

$$Water\ consumption = \frac{\frac{Faucet\ Use\ per\ Person}{Day} \times Occupants\ per\ Home \times \frac{365\ Days}{Year}}{Faucets\ per\ Home}$$

[89] Burch, J & Christensen, C. 2007. “Towards Development of an Algorithm for Mains Water Temperature.” Proceedings of the 2007 ASES Annual Conference, Cleveland, OH.

[90] Seattle Home Water Conservation Study, 2000. “The Impacts of High Efficiency Plumbing Fixture Retrofits in Single-Family Homes.” December. http://www.allianceforwaterefficiency.org/mainsearch.aspx?searchtext=Seattle%20Home%20Water%20Conservation%20Study

[91] Residential Indoor Water Conservation Study, 2003 “Evaluation of High Efficiency Indoor Plumbing Fixture Retrofits in Single-Family Homes in the East Bay Municipal Utility District Service Area.” July. www.allianceforwaterefficiency.org/WorkArea/DownloadAsset.aspx?id=868

92 Tampa Water Department Residential Water Conservation Study, 2004, “The Impacts of High Efficiency Plumbing Fixture Retrofits in Single-Family Homes.” January 8. https://www.cuwcc.org/Portals/0/Document%20Library/Resources/Water%20Efficient%20Product%20Information/End%20Use%20Studies%20-%20Multiple%20Technologies/Tampa-Residential-Water-Conservation-Final-Report.pdf

Applying the formula to the values from Table 35 returns the following baseline and post water consumption.

Baseline (2.2 GPM): 9.7 x 2.37 x 365 / 3.86 =2,174

Post (1.5 GPM): 8.2 x 2.37 x 365 / 3.86 = 1,838

Post (1.0 GPM): 7.2 x 2.37 x 365 / 3.86 = 1,614

Gallons of water saved per year can be found by subtracting the post consumption in gallons per year per aerator from the baseline consumption.

- Gallons of water saved per year (1.5 GPM): 2,174 – 1,838= 336
- Gallons of water saved per year (1.0 GPM): 2,174 – 1,614 = 560

Table 34: Estimated Aerator Hot Water Usage Reduction

Assumption Type	***Seattle Study***[93]	***Tampa Study***[94]	***East Bay Study***	***Average***	***Value used for New Orleans***
Faucet use gallons/person/day (baseline)	9.2	9.4	10.5	9.7	9.7
Faucet use gallons/person/day (1.5 GPM)	8.0	6.2	10.5	8.2	8.2
Faucet use gallons/person/day (1.0 GPM)[95]	--	--	--	--	7.2
Occupants per home	2.54	2.92	2.56	2.67	2.37[96]
Faucets per home[97]	--	--	--	--	3.86
Gal./yr./faucet (baseline)	--	--	--	--	2,467
Gal./yr./faucet (1.5 GPM)	--	--	--	--	2,086
Gal./yr./faucet (1.0 GPM)	--	--	--	--	1,831
Percent hot water	76.10%4	Not listed	57.60%5	66.90%	66.9%
Water gallons saved/yr./faucet (1.5 GPM)	--	--	--	--	336

[93] Average of pre-retrofit percent faucet hot water 72.7% on page 35, and post-retrofit percent faucet hot water 79.5% on page 53.

[94] Average of pre-retrofit percent faucet hot water 65.2% on page 31 and post-retrofit faucet hot water percentage 50.0% on page 54.

[95] This value is a linear extrapolation of gallons per person per day from the baseline (2.2 GPM) and the 1.5 GPM case.

[96] 2010-2014, US Census Bureau. http://www.census.gov/quickfacts/table/PST045215/2255000

[97] Faucets per home assumed to be equal to one plus the number half bathrooms and full bathrooms per home, taken from 2009 RECS, Table HC2.10.

Assumption Type	Seattle Study[93]	Tampa Study[94]	East Bay Study	Average	Value used for New Orleans
Water gallons saved/yr./faucet (1.0 GPM)	--	--	--	--	560

Based on the average percentage hot water shown in Table 34, the average mixed water temperature across all weather zones was determined. The hot water temperature was found to be 122.24°F in a sample of 37 homes in New Orleans tested by ADM. The mixed water temperature used in the energy savings calculation can be seen in Table 35.

Table 35: Mixed Water Temperature Calculation

Weather Zone	Average Water Main Temperature (°F)	Percent Hot Water	Mixed Water Temperature (°F)
New Orleans	74.8	66.9%	106.5

B.2.4.4. Calculation of Deemed Savings

B.2.4.4.1. Energy Savings

$$Annual\ Energy\ Savings = \frac{\rho \times C_P \times V \times (T_{Mixed} - T_{Supply}) \times \left(\frac{1}{RE}\right)}{Conversion\ Factor}$$

Where:

ρ = Water density = 8.33 lb/gal

C_P = Specific heat of water = 1 BTU/lb·°F

V = Gallons of water saved per year per faucet from Table 35

T_{Mixed} = Mixed water temperature, 106.5°F, from Table 35

T_{Supply} = Average New Orleans area supply water temperature, 74.8°F

RE = Recovery Efficiency (or in the case of HPWH, EF); if unknown, use 0.98 as a default for electric resistance water heaters, 2.2 for heat pump water heaters, or 0.79 for natural gas water heaters[98].

$Conversion\ Factor$ = 3,412 Btu/kWh for electric water heating or 100,000 Btu/Therm for gas water heating

98 Default values based on median recovery efficiency of residential water heaters by fuel type in the AHRI database, at https://www.ahridirectory.org/ahridirectory/pages/rwh/defaultSearch.aspx

B.2.4.4.2. Demand Savings

Demand savings for homes with electric water heating were calculated using the following formula:

$$kW_{savings} = kWh_{savings} \times Ratio_{Annual\ kWh}^{Peak\ kW}$$

Where:

$Ratio_{Annual\ kWh}^{Peak\ kW}$ = 0.000104

This value is taken from the DOE domestic hot water use study.[99] The DOE domestic hot water use study provided values for the share of daily water use per hour in a profile for shower bath, and sink hot water use. An average was calculated using peak hours of 3 PM to 6 PM to generate an average hourly share of daily water use during peak hours. That value was divided by 365 to generate a ratio of peak share to annual use.

B.2.4.4.3. Example Calculation of Deemed Savings Values

Deemed savings values are per faucet aerator installed.

Table 36: Example -Replacing 2.2 GPM with 1.5 GPM Faucet Aerator

Faucet Aerator, New Orleans Weather Zone		
Water Usage Reduction (gal)	336	
T_{Supply}	74.8F	
T_{Mixed}	106.5°F	
Water heater RE (excluding standby losses)	0.98 (Electric) / 2.2 (Heat Pump)	
Energy Savings	Electric: 26.5 kWh	Heat Pump: 11.82 kWh
Demand Savings	Electric: 0.0028 kW	Heat Pump: 0.0012 kW

B.2.4.5. Future Studies

To-date, Energy Smart evaluations have provided two primary research points for this measure:

- New Orleans water main temperature;
- Water heater setpoint.

[99] U.S. DOE's 2006. "*Building America Performance Analysis Procedures for Existing Homes*". *National Renewable Energy Laboratory.* May. http://www.nrel.gov/docs/fy06osti/38238.pdf (See Figure 3, page 17.) This TRM looked at hourly share of daily water use at 3pm 4pm, 5pm, and 6pm in Figure 3. The fractions of hourly use derived were 0.022 for 3pm, 0.03 for 4pm, 0.04 for 5pm, and 0.06 for 6pm. The average of these fractions is 0.038, which is the average share of daily water use that falls on a peak hour per day. Dividing that value by 365 days calculates a ratio of 0.000104 as the ratio of peak share to annual use.

The water main temperature is a fixed value based on TMY3 weather data. The water heater setpoint should be supplemented with additional data collection in PY7.

Metering studies for water use are exceedingly expensive. In past metering efforts, ADM has found costs to exceed $750 per site. As such, we do not advise a metering study for this measure unless savings exceed 5% of residential program savings.

B.2.5. Low-Flow Showerheads

B.2.5.1. Measure Description

This measure consists of removing existing showerheads and installing low-flow showerheads in residences. This measure applies to all residential applications.

B.2.5.2. Baseline and Efficiency Standards

The baseline average flow rate of the existing stock of showerheads is based on the current US DOE standard.

The incentive is for replacement of an existing showerhead with a new showerhead rated at 2.0, 1.75 or 1.5 gallons per minute (GPM). The only showerheads eligible for installation are those that are not easily modified to increase the flow rate.

B.2.5.3. Additional Requirement for Contractor-Installed Showerheads

Existing showerheads that have been defaced so as to make the flow rating illegible are not eligible for replacement. All showerheads removed shall be collected by the contractor and held for possible inspection by the utility until all inspections for invoiced installations have been completed.

Table 37: Low-Flow Showerhead – Baseline and Efficiency Standards

Measure	*New Showerhead Flow Rate[100] (GPM)*	*Existing Showerhead Baseline Flow Rate (GPM)*
2.0 GPM showerhead	2.0	2.5
1.75 GPM showerhead	1.75	2.5
1.5 GPM showerhead	1.5	2.5

The U.S. Environmental Protection Agency (EPA) WaterSense Program has implemented efficiency standards for showerheads requiring a maximum flow rate of 2.0 GPM. http://www1.eere.energy.gov/femp/program/waterefficiency_bmp7.html.

B.2.5.4. Estimated Useful Life (EUL)

The average lifetime of this measure is 10 years, according to DEER 2014.

[100] All flow rate requirements listed here are the rated flow of the showerhead measured at 80 pounds per square inch of pressure (psi).

B.2.5.1. Deemed Savings

Table 38: Low Flow Showerhead Retrofit Deemed Energy Savings

2.0 GPM Showerhead		
Water gal. saved /year/showerhead @ 2.0 GPM	1,283	
T_{Supply}	74.8°F	
T_{Mixed}	106.5°F	
Water heater RE	0.98 (Electric Resistance) / 2.2 (Heat Pump)	
Energy Savings	Electric: 101 kWh	Heat Pump:45 kWh
Demand Savings	Electric: 0.0105kW	Heat Pump: 0.0047 kW
1.75 GPM Showerhead		
Water gal. saved /year/showerhead @ 1.5 GPM	2,071	
T_{Supply}	74.8°F	
T_{Mixed}	105.0°F	
Water heater EF (excluding standby losses)	0.98 (Electric Resistance) / 2.2 (Heat Pump)	
Energy Savings	Electric: 164 kWh	Heat Pump: 73 kWh
Demand Savings	Electric: 0.0170 kW	Heat Pump:0.0076 kW
1.5 GPM Showerhead		
Water gal. saved /year/showerhead @ 1.5 GPM	2,860	
T_{Supply}	74.8°F	
T_{Mixed}	105.0°F	
Water heater EF (excluding standby losses)	0.98 (Electric Resistance) / 2.2 (Heat Pump)	
Energy Savings	Electric: 226 kWh	Heat Pump: 101 kWh
Demand Savings	Electric: 0.0235 kW	Heat Pump: 0.0105 kW

B.2.5.2. Effect of Weather Zones on Water Usage and Water Main Temperature

Average water main temperatures is 74.8. The water main temperature data was approximated using the following formula.[101]

$$T\ of\ water\ main = T_{avg\ ambient} + R \times \Delta T_{amb}$$

[101] Burch, J. & Christensen, C. 2007. *"Towards Development of an Algorithm for Mains Water Temperature"* Proceedings of the 2007 ASES Annual Conference, Cleveland, OH.

Where:

R = 0.05

$T_{avg\ ambient}$ = the average annual ambient dry bulb temperature

ΔT_{amb} = 74.8 (New Orleans), the average of maximum and minimum ambient air dry bulb temperature for the month (Tmax + Tmin)/2 where Tmax = maximum ambient dry bulb temperature for the month and Tmin = minimum ambient dry bulb temperature for the month

B.2.5.3. Estimated Hot Water Usage Reduction

Baseline and efficiency standard water usages per capita were derived from an analysis of metered studies of residential water efficiency retrofit projects conducted for Seattle, WA.; the East Bay Municipal Utility District (CA); and Tampa, FL.[102,103,104] See Table 39 for derivation of water usage values.

To determine water consumption, the following formula was used:

$$\frac{Gallons}{Shower} \times \frac{Showers\ per\ Person}{Day} \times \frac{365\ Days}{Year} \times \frac{Occupants\ per\ Home}{Showerheads\ per\ Home}$$

Applying the formula to the values from Table 39 returns the following baseline and post water consumption.

- Baseline (2.5 GPM): 20.7 x 0.69 x 365 x 2.37 / 1.62 = 7,627
- Post (2.0 GPM): 16.5 x 0.72 x 365 x 2.37 / 1.62 = 6,344
- Post (1.5 GPM): 12.4 x 0.72 x 365 x 2.37 / 1.62 = 4,767

Although the referenced studies do not provide data on 1.75 GPM showerheads, the consumption values for 2.5, 2.0, and 1.5 GPM roughly follow a linear pattern. Taking a simple average of the consumption for 2.0 and 1.5 GPM showerheads returns a value for a 1.75 GPM showerhead:

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102 Seattle Home Water Conservation Study, 2000. "The Impacts of High Efficiency Plumbing Fixture Retrofits in Single-Family Homes." December.

http://www.allianceforwaterefficiency.org/mainsearch.aspx?searchtext=Seattle Home Water Conservation Study

103 Residential Indoor Water Conservation Study, 2003. "Evaluation of High Efficiency Indoor Plumbing Fixture Retrofits in Single-Family Homes in the East Bay Municipal Utility District Service Area." July. http://www.allianceforwaterefficiency.org/WorkArea/DownloadAsset.aspx?id=868

104 Tampa Water Department Residential Water Conservation Study, 2004, *"The Impacts of High Efficiency Plumbing Fixture Retrofits in Single-Family Homes,"* January 8. https://www.cuwcc.org/Portals/0/Document%20Library/Resources/Water%20Efficient%20Product%20Information/End%20Use%20Studies%20-%20Multiple%20Technologies/Tampa-Residential-Water-Conservation-Final-Report.pdf

- Post (1.75 GPM): (6,344 + 4,767) / 2 = 5,556

Gallons of water saved per year can be found by subtracting the post consumption in gallons per year per showerhead from the baseline consumption. These values are also in Table 39.

- Gallons of water saved per year (2.0 GPM): (7,627 – 6,344) = 1,283
- Gallons of water saved per year (1.75 GPM): (7,627 – 5,556) = 2,071
- Gallons of water saved per year (1.5 GPM): (7,627 – 4,767) = 2,860

Table 39: Estimated Showerhead Hot Water Usage Reduction

Assumption Type	***Seattle Study[105]***	***Tampa Study***	***East Bay Study[106]***	***Average***	***Value used for New Orleans***
Gallons/shower @ 2.5 GPM (baseline)	19.8	20.0	22.3	20.7	20.7
Gallons/shower @ 2.0 GPM	15.8	16.0	17.8	16.5	16.5
Gallons/shower @ 1.5 GPM	11.9	12.0	13.4	12.4	12.4
Showers/person/day (baseline)	0.51	0.92	0.65	0.69	0.69
Showers/person/day (post)	0.59	0.82	0.74	0.72	0.72
Occupants per home	2.54	2.92	2.56	2.67	2.37[107]
Showerheads per home[108]	not listed	not listed	not listed	not listed	1.62
Water gal./yr./showerhead @ 2.0 GPM saved	not listed	not listed	not listed	not listed	1,823
Water gal./yr./showerhead @ 1.75 GPM saved	not listed	not listed	not listed	not listed	2,071
Water gal./yr./showerhead @ 1.5 GPM saved	not listed	not listed	not listed	not listed	2,860
Percent hot water	74.3%	not listed	66%	70.1%	70.1%

Based on the average percentage hot water shown in, Table 39, the average mixed water temperature across all weather zones was determined. The hot water

[105] Seattle Study: Average of pre-retrofit percent shower hot water 73.1% on page 35, and post-retrofit percent shower hot water 75.5% on p. 53.

[106] East Bay Study: Average of pre-retrofit percent shower hot water 71.9% on page 31 and post-retrofit shower hot water percentage 60.0% on p. 54.

[107] 2010-2014, US Census Bureau. http://www.census.gov/quickfacts/table/PST045215/2255000

[108] Showerheads per home assumed to be equal to the number of full bathrooms per home, taken from 2009 RECS, Table HC2.10.

temperature was found to be 122.24°F in a sample of 37 homes in New Orleans tested by ADM. The mixed water temperature used in the energy savings calculation can be seen in Table 40.

Table 40: Mixed Water Temperature Calculation

Weather Zone	Average Water Main Temperature (°F)	Percent Hot Water	Mixed Water Temperature (°F)
New Orleans	74.8	66.9%	106.5

B.2.5.4. Calculation of Deemed Savings

B.2.5.4.1. Energy Savings

$$Annual\ Energy\ Savings = \frac{\rho \times C_P \times V \times (T_{Mixed} - T_{Supply}) \times \left(\frac{1}{RE}\right)}{Conversion\ Factor}$$

Where:

ρ = Water density = 8.33 lb/gallon

C_P = Specific heat of water = 1 BTU/lb·°F

V = 2.0, 1.75, or 1.5 GPM showerhead water gallons saved per year (from Table 39)

T_{Mixed} = Mixed water temperature, 106.5°F, from Table 40

T_{Supply}= Average New Orleans area supply water temperature, 74.8°F

RE= Recovery Efficiency (or in the case of HPWH, EF); if unknown, use 0.98 as a default for electric resistance water heaters, 2.2 for heat pump water heaters,

$Conversion\ Factor$ = 3,412 Btu/kWh for electric water heating or 100,000 Btu/Therm for gas water heating

B.2.5.4.2. Demand Savings

Demand savings were calculated using the US Department of Energy's "Building America Performance Analysis Procedures for Existing Homes"[109] combined domestic hot water use profile which resulted in a ratio of 0.000104 Peak kW to Annual kWh. The DOE domestic hot water use study provided values for the share of daily water use per hour in a profile for shower, bath, and sink hot water use. An average was calculated using peak hours of 3pm to 6pm to generate an average hourly share of daily water use

[109] U.S. DOE's 2006, *"Building America Performance Analysis Procedures for Existing Homes"*. National Renewable Energy Laboratory. May. www.nrel.gov/docs/fy06osti/38238.pdf

during peak hours. That value was divided by 365 to generate a ratio of peak share to annual use.[110]

$$kW_{savings} = kWh_{\ savings} \times Ratio_{Annual\ kWh}^{Peak\ kW}$$

B.2.5.1. Future Studies

To-date, Energy Smart evaluations have provided two primary research points for this measure:

- New Orleans water main temperature;
- Water heater setpoint.

The water main temperature is a fixed value based on TMY3 weather data. The water heater setpoint should be supplemented with additional data collection in PY7.

Metering studies for water use are exceedingly expensive. In past metering efforts, ADM has found costs to exceed $750 per site. As such, we do not advise a metering study for this measure unless savings exceed 5% of residential program savings.

[110] At 3pm, the hourly share of daily water use is 0.022, at 4pm is 0.03, at 5pm is 0.04, and at 6pm is 0.06. The average of these values is 0.038. Divided by 365 days, the result is a 0.000104 ratio of peak share to annual use.

B.3. HVAC

B.3.1. Central Air Conditioner Replacement

B.3.1.1. Measure Description

This measure involves a residential retrofit with a new central air conditioning system or the installation of a new central air conditioning system in a residential new construction (packaged unit, or split system consisting of an indoor unit with a matching remote condensing unit). Maximum cooling capacity per unit is 65,000 BTU/hour. This measure applies to all residential applications.

B.3.1.2. Baseline and Efficiency Standards[111]

For new construction (NC) and ROB projects, the cooling baseline is 14 SEER, consistent with the current federal minimum standard[112].

For Early Replacement projects, the baseline is consistent with the previous federal standard. The cooling baseline is 13 SEER (code which took effect January 23, 2006).

For Early Replacement, the maximum lifetime age of an eligible piece of equipment is capped at the point at which it is expected that 75 percent of the equipment has failed. Where the age of the unit exceeds the 75 percent failure age, ROB savings should be applied. This cap prevents early retirement savings from being applied to projects where the age of the equipment greatly exceeds the estimated useful life of the measure.

Air conditioning equipment shall be properly sized to the dwelling, based on ASHRAE or ACCA Manual J standards. Manufacturer data sheets on installed air conditioning equipment or the AHRI reference number must be provided to the utility. The installed central air conditioning equipment must be AHRI certified.

Table 41: Central Air Conditioner – Baseline and Efficiency Levels

	SEER	***EER***
New Construction and Normal Replacement	14	11.8
Early Replacement	13	11.2
Required Efficiency	15	12.5 (split) 12.0 (packaged)

[112] DOE minimum efficiency standard for residential air conditioners/heat pumps. www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75.

B.3.1.3. Estimated Useful Life (EUL)

The average lifetime of this measure is 19 years, according to the US DOE.[113]

B.3.1.1. Deemed Savings

Table 42: High Efficiency Central AC Deemed kWh

Efficiency	***kWh Saved per Ton***	***Average Tons[114]***	***kWh if Tonnage Unknown***
15 SEER	93.54	3.65	341.43
16 SEER	175.39	3.65	640.18
17 SEER	247.61	3.65	903.79
18 SEER	311.81	3.65	1,138.10
19 SEER	369.25	3.65	1,347.76
20 SEER	420.94	3.65	1,536.44
21 SEER	467.71	3.65	1,707.16

Table 43: High Efficiency Central AC Deemed kW

Efficiency	***kW Saved per Ton***	***Average Tons[115]***	***kW if Tonnage Unknown***
12 EER	0.0131	3.65	0.0476
13 EER	0.0723	3.65	0.2638
14 EER	0.1231	3.65	0.4491
15 EER	0.1671	3.65	0.6097
16 EER	0.2056	3.65	0.7503
17 EER	0.2395	3.65	0.8743
18 EER	0.2697	3.65	0.9845

[113] U.S. DOE, 2011 *Technical Support Document:* "*Residential Central Air Conditioners, Heat Pumps, and Furnaces, 8.2.3.5 Lifetime.*" June www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75.

[114] Value from PY6 Residential Heating & Cooling Program

[115] Value from PY6 Residential Heating & Cooling Program

B.3.1.2. Deemed Savings Calculations

B.3.1.2.1. Replace-on-Burnout

$$kW_{Savings} = CAP_c \times \frac{1}{1{,}000} W/_{kW} \times \left(\frac{1}{EER_{base}} - \frac{1}{EER_{Eff}}\right) \times \%CF$$

$$kWh_{Savings} = CAP_c \times \frac{1}{1{,}000} W/_{kW} \times \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{Eff}}\right) \times EFLH_C$$

Where,

CAP_c = Cooling capacity (in BTU)

EER_{base} = Full-load efficiency of baseline equipment (see Table 41)

EER_{eff} = Full-load efficiency of baseline equipment (see Table 41)

$SEER_{base}$ = Seasonal efficiency of baseline equipment (see Table 41)

$SEER_{eff}$ = Seasonal efficiency of efficient equipment (see Table 41)

EFLHc = Equivalent Full-Load Cooling Hours

%CF = Peak Coincidence Factor

B.3.1.2.2. Equivalent Full-Load Hours

Equivalent Full-Load Cooling Hours (EFLHc) measures the total annual runtime of HVAC equipment. To support development of this value, the usage of 68 HVAC systems in New Orleans was metered. This runtime was then normalized to correspond to Typical Meteorological Year (“TMY”) weather data for New Orleans.

The resulting EFLHc is 1,637.

B.3.1.2.3. Peak Coincidence Factor

The Peak Coincidence Factor is defined as the percent time during the ENO peak period where the residential central air conditioner is operational. Peak hours were defined as:

- Weekdays
- Non-holidays
- 4:00-5:00 PM
- Average ambient temperature exceeding 90 degrees Fahrenheit.

The average central AC runtime during qualified hours was 77%. This peak coincidence factor is applied to calculate peak kW demand reductions from this measure.

B.3.1.2.4. Uncertainty Analysis

The uncertainties associated with the two key parameters collected in EM&V are as follows:

- EFLHc: ±7.81%
- % Coincidence: ±2.11%

B.3.1.3. Incremental Cost

The incremental cost of high central air conditioners is detailed in Table 44.[116]

Table 44 High Efficiency Central AC Replacement Incremental Costs

Product Type	Incremental Cost Per Ton
15 SEER	$119
16 SEER	$238
17 SEER	$357
18 SEER	$477
19 SEER	$596
20 SEER	$715
21 SEER	$789

B.3.1.4. Future Studies

This measure should be considered for supplementary data collection pertaining to runtime and peak coincidence in three years (PY9, program year 2019-2020).

[116] CA DEER 2014

B.3.2. Window Air Conditioner Replacement

B.3.2.1. Measure Description

This measure involves the replacement of a window air conditioner in a residential building.

B.3.2.2. Baseline and Efficiency Standards[117]

The baseline is a new air conditioning unit with a combined energy efficiency ratio (CEER) that meets federal standards established on June 1, 2014[118].

Efficient units must meet ENERGY STAR standards, requiring 10% efficiency above federal minimum requirements.

Table 45: Window Air Conditioner – Baseline and Efficiency Levels

Reverse Cycle?	*Louvered Sides?*	*Capacity*	*Baseline CEER*	*Efficient CEER*	*kWh*	*kW*
No	Yes	< 8,000	11.0	12.1	46.4	0.0445
		≥ 8,000 and < 14,000	10.9	12.0	74.2	0.0453
		≥ 14,000 and < 20,000	10.7	11.8	118.8	0.0470
		≥ 20,000	9.4	10.3	171.5	0.0501
	No	< 8,000	10.0	11.0	51.0	0.0490
		≥ 8,000	9.6	10.6	78.8	0.0530
Yes	Yes	< 20,000	9.8	10.8	113.7	0.0509
		≥ 20,000	9.3	10.2	190.3	0.0511
	No	< 14,000	9.3	10.2	83.7	0.0511
		≥ 14,000	8.7	9.6	146.9	0.0581

B.3.2.3. Estimated Useful Life (EUL)

According to the DOE's Technical Support Document, Chapter 8: Life Cycle Cost and Payback Period Analyses 2011, the measure life is 10.5 years.

[118] 10 CFR 430.32(b). https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=52&action=viewlive#current_standards

B.3.2.4. Deemed Savings Calculations

B.3.2.4.1. Replace-on-Burnout

$$kW_{Savings} = CAP_c \times \frac{1}{1{,}000} {}^{W}\!/_{kW} \times \left(\frac{1}{CEER_{base}} - \frac{1}{CEER_{Eff}}\right) \times \%CF$$

$$kWh_{Savings} = CAP_c \times \frac{1}{1{,}000} {}^{W}\!/_{kW} \times \left(\frac{1}{CEER_{base}} - \frac{1}{CEER_{Eff}}\right) \times EFLH_C \times RAF$$

Where,

CAP_c = Cooling capacity (in BTU)

EER_{base} = Full-load efficiency of baseline equipment (see Table 45)

EER_{eff} = Full-load efficiency of baseline equipment (see Table 45)

$SEER_{base}$ = Seasonal efficiency of baseline equipment (see Table 45)

$SEER_{eff}$ = Seasonal efficiency of efficient equipment (see Table 45)

EFLHc = Equivalent Full-Load Cooling Hours, 1,637

%CF = Peak Coincidence Factor, 77%

RAF = Room AC Adjustment Factor, .49[119]

B.3.2.4.2. Equivalent Full-Load Hours

Equivalent Full-Load Cooling Hours (EFLHc) measures the total annual runtime of HVAC equipment. To support development of this value, the usage of 68 HVAC systems in New Orleans was metered. This runtime was then normalized to correspond to Typical Meteorological Year ("TMY") weather data for New Orleans.

The resulting EFLHc is 1,637.

119 This is a factor derived from the ENERGY STAR calculator which corrects for the fact that window AC's are typically not run as often as central AC systems. This value comes from the Arkansas TRM, which developed estimates based on the ENERGY STAR Room AC calculator.

B.3.2.4.3. Peak Coincidence Factor

The Peak Coincidence Factor is defined as the percent time during the ENO peak period where the residential central air conditioner is operational. Peak hours were defined as:

- Weekdays
- Non-holidays
- 4:00-5:00 PM
- Average ambient temperature exceeding 90 degrees Fahrenheit.

The average central AC runtime during qualified hours was 77%. This peak coincidence factor is applied to calculate peak kW demand reductions from this measure.

B.3.2.4.4. Uncertainty Analysis

The uncertainties associated with the two key parameters collected in EM&V are as follows:

- EFLHc: ±7.81%
- % Coincidence: ±2.11%

B.3.2.5. Incremental Cost

The incremental cost of high central air conditioners is $50[120].

B.3.2.6. Future Studies

This measure should be considered for supplementary data collection pertaining to runtime and peak coincidence in three years (PY9, program year 2019-2020).

[120] ENERGY STAR Room AC Calculator.

B.3.3. Heat Pump Replacement

B.3.3.1. Measure Description

This measure involves a residential retrofit with a new neat pump system or the installation of a new heat pump system in a residential new construction (packaged unit, or split system consisting of an indoor unit with a matching remote condensing unit). Maximum cooling capacity per unit is 65,000 BTU/hour. This measure applies to all residential applications.

B.3.3.2. Baseline and Efficiency Standards[121]

For new construction (NC) and ROB projects, the cooling baseline is 14 SEER and 8.0 HSPF, consistent with the current federal minimum standard[122].

For Early Replacement projects, the baseline is consistent with the previous federal standard. The cooling baseline is 13 SEER (code which took effect January 23, 2006).

For Early Replacement, the maximum lifetime age of an eligible piece of equipment is capped at the point at which it is expected that 75 percent of the equipment has failed. Where the age of the unit exceeds the 75 percent failure age, ROB savings should be applied. This cap prevents early retirement savings from being applied to projects where the age of the equipment greatly exceeds the estimated useful life of the measure.

Heat Pump equipment shall be properly sized to the dwelling, based on ASHRAE or ACCA Manual J standards. Manufacturer data sheets on installed air conditioning equipment or the AHRI reference number must be provided to the utility. The installed central air conditioning equipment must be AHRI certified.

Table 46: Heat Pump – Baseline and Efficiency Levels

	SEER	***EER***	***HSPF***
New Construction and Normal Replacement	14	11.8	8.2 (split) 8.0 (packaged)
Early Replacement – Heat Pump	13	11.2	7.7 (split & packaged)
Required Efficiency	15	12.5 (split) 12.0 (packaged)	9.0

122 DOE minimum efficiency standard for residential air conditioners/heat pumps. www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75.

B.3.3.3. Estimated Useful Life (EUL)

The average lifetime of this measure is 16 years, according to the US DOE.[123]

B.3.3.1. Deemed Savings

B.3.3.1.1. Cooling kWh and kW Savings

Table 47: High Efficiency Heat Pump Deemed Cooling kWh Savings

Efficiency	***kWh Saved per Ton***	***Average Tons***[124]	***kWh if Tonnage Unknown***
15 SEER	93.54	3.65	341.43
16 SEER	175.39	3.65	640.18
17 SEER	247.61	3.65	903.79
18 SEER	311.81	3.65	1,138.10
19 SEER	369.25	3.65	1,347.76
20 SEER	420.94	3.65	1,536.44
21 SEER	467.71	3.65	1,707.16

Table 48: High Efficiency Heat Pump Deemed Cooling kW Savings

Efficiency	***kW Saved per Ton***	***Average Tons***[125]	***kW if Tonnage Unknown***
12 EER	0.0131	3.65	0.0476
13 EER	0.0723	3.65	0.2638
14 EER	0.1231	3.65	0.4491
15 EER	0.1671	3.65	0.6097
16 EER	0.2056	3.65	0.7503
17 EER	0.2395	3.65	0.8743
18 EER	0.2697	3.65	0.9845

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[123] US U.S. DOE, 2011. *Technical Support Document: "Residential Central Air Conditioners, Heat Pumps, and Furnaces, 8.2.3.5 Lifetime*". June. www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75.

[124] Value from PY6 Residential Heating & Cooling Program

[125] Value from PY6 Residential Heating & Cooling Program

B.3.3.1.2. Heating kWh Savings

Table 49: High Efficiency Heat Pump Deemed Cooling kWh Savings – ROB/NC

Efficiency	kWh Saved per Ton	Average Tons[126]	kWh if Tonnage Unknown
15 SEER	186.33	3.65	680.12
16 SEER	335.40	3.65	1,224.21
17 SEER	457.36	3.65	1,669.38
18 SEER	559.00	3.65	2,040.35
19 SEER	645.00	3.65	2,354.25
20 SEER	718.71	3.65	2,623.31
21 SEER	782.60	3.65	2,856.49

B.3.3.2. Deemed Savings Values

B.3.3.2.1. Replace-on-Burnout

B.3.3.2.1.1. Cooling Savings

$$kW_{Savings} = CAP_c \times 1{,}000\, {}^{W}/_{kW} \times \left(\frac{1}{EER_{base}} - \frac{1}{EER_{Eff}}\right) \times \%CF$$

$$kWh_{Savings} = CAP_c \times 1{,}000\, {}^{W}/_{kW} \times \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{Eff}}\right) \times EFLH_C$$

Where,

CAP_c = Cooling capacity (in BTU)

EER_{base} = Full-load efficiency of baseline equipment (see Table 51)

EER_{eff} = Full-load efficiency of baseline equipment (see Table 51)

$SEER_{base}$ = Seasonal efficiency of baseline equipment (see Table 51)

$SEER_{eff}$ = Seasonal efficiency of efficient equipment (see Table 51)

[126] Value from PY6 Residential Heating & Cooling Program

EFLHc = Equivalent Full-Load Cooling Hours

%CF = Peak Coincidence Factor

B.3.3.2.1.1.1. Equivalent Full-Load Cooling Hours

Equivalent Full-Load Cooling Hours (EFLHc) measures the total annual runtime of HVAC equipment. To support development of this value, the usage of 68 HVAC systems in New Orleans was metered. This runtime was then normalized to correspond to Typical Meteorological Year ("TMY") weather data for New Orleans.

The resulting EFLHc is 1,637.

B.3.3.2.1.1.2. Peak Coincidence Factor

The Peak Coincidence Factor is defined as the percent time during the ENO peak period where the residential central air conditioner is operational. Peak hours were defined as:

- Weekdays
- Non-holidays
- 4:00-5:00 PM
- Average ambient temperature exceeding 90 degrees Fahrenheit.

The average central AC runtime during qualified hours was 77%. This peak coincidence factor is applied to calculate peak kW demand reductions from this measure.

B.3.3.2.1.1.3. Heating Energy Savings

Heating savings are calculated with the following formula:

$$kWh_{Savings} = CAP_c \times 1{,}000\, {}^{W}/_{kW} \times \left(\frac{1}{HSPF_{base}} - \frac{1}{HSPF_{Eff}}\right) \times EFLH_h$$

Where,

CAP_c = Cooling capacity (in BTU)

EER_{base} = Full-load efficiency of baseline equipment (see Table 46)

EER_{eff} = Full-load efficiency of baseline equipment (see Table 46)

$HSPF_{base}$ = Heating Season Performance Factor of baseline equipment (see Table 46)

$HSPF_{eff}$ = Heating Season Performance Factor of efficient equipment (see Table 46)

$EFLH_h$ = Equivalent Full-Load Heating Hours

%CF = Peak Coincidence Factor

B.3.3.2.1.1.4. Equivalent Full Load Heating Hours

A stipulated EFLH of 1,118 is applied when calculating heating savings from heat pumps. This value cites the ENERGY STAR Heat Pump calculator. There has not been a metering study performed to revise this value due to the low participation rate for heat pumps.

B.3.3.2.2. Uncertainty Analysis

The uncertainties associated with the two key parameters collected in EM&V are as follows:

- EFLHc: ±7.81%
- % Coincidence: ±2.11%

B.3.3.3. Incremental Cost

The incremental cost of high central air conditioners is detailed in Table 50[127].

Table 50: High Efficiency Central Heat Pump Replacement Incremental Costs

Product Type	Incremental Cost Per Ton
15 SEER	$303
16 SEER	$438
17 SEER	$724
18 SEER	$724

B.3.3.4. Future Studies

As with Central Air Conditioning, the cooling side of this measure should be considered for supplementary data collection pertaining to runtime and peak coincidence in three years (PY9, program year 2019-2020).

If heat pump replacement and tune-up ever exceed 1% of program kWh savings, it is recommended to conduct a metering study to validate $EFLH_h$ estimates for heating season savings.

[127] CA DEER 2014

B.3.4. Ground Source Heat Pump Replacement

B.3.4.1. Measure Description

This measure involves the installation of water-to-air ground source heat pump as a replacement for an existing air-source heat pump. Maximum cooling capacity per unit is 65,000 BTU/hour. This measure applies to all residential applications.

B.3.4.2. Baseline and Efficiency Standards[128]

For new construction (NC) and ROB projects, the cooling baseline is 14 SEER and 8.0 HSPF, consistent with the current federal minimum standard[129]. Due to the high cost of this equipment, all projects are assumed to be replacement on burnout or new construction.

Heat Pump equipment shall be properly sized to the dwelling, based on ASHRAE or ACCA Manual J standards. Manufacturer data sheets on installed air conditioning equipment or the AHRI reference number must be provided to the utility. The installed central air conditioning equipment must be AHRI certified.

Table 51: Heat Pump – Baseline and Efficiency Levels

	SEER	***EER***	***HSPF***
New Construction and Normal Replacement	14	11.8	8.2 (split) 8.0 (packaged)
Early Replacement – Heat Pump	13	11.2	7.7 (split & packaged)
Early Replacement – Electric Resistance	13	11.2	3.41
Energy Star Criteria – Water-to-Air		Closed Loop: 17.1 Open Loop: 21.1	Closed Loop: 12.3 Open Loop: 14.0
Energy Star Criteria – Water-to-Water		Closed Loop: 16.1 Open Loop: 20.1 DGX: 16	Closed Loop: 10.6 Open Loop: 11.9 DGX: 12.3

B.3.4.3. Estimated Useful Life (EUL)

The average lifetime of this measure is 25 years, according to the US DOE.[130]

[129] DOE minimum efficiency standard for residential air conditioners/heat pumps. www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75.

[130] Source DOE Energy Savers website: www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12640 .

B.3.4.4. Deemed Savings Values

Savings are calculated in the same manner as for Heat Pump Replacement. See Section B.3.3.2. According to the current ENERGY STAR database[131], the average efficiency of ENERGY STAR-rated ductless units that are currently in production is as follows:

- COP: 4.30 (this converts to a SEER rating of 20.86 and HSPF of 14.67)
- EER: 24.60
- HSPF: 10.43

The average capacity of these units is 3.54 tons for central heat pump replacements, based on the prior-year participation in ENO's Residential Heating and Cooling Program.

The resulting average unit energy savings for a geothermal heat pump are detailed in the table below.

Table 52: Geothermal Heat Pump Average Savings

	kWh Per Ton	***kW per Ton***	***Average Tons***	***kWh per Unit***	***kW per Unit***
New Construction and Normal Replacement	1,183	.4074	3.65	4,318	1.49
Early Replacement – Heat Pump	1,397	.4494	3.65	5,099	1.64
Early Replacement – Electric Resistance	3,589	.4494	3.65	13,100	1.64

B.3.4.5. Incremental Cost

The incremental cost should use the full installed cost, minus an assumed installation cost of baseline equipment. The baseline cost is $1,381 per ton for a minimum-efficient air source heat pump[132].

131 https://data.energystar.gov/Active-Specifications/ENERGY-STAR-Most-Efficient-Geothermal-Heat-Pumps/4c82-7ysy

132 Based on data provided on Home Advisor website, providing national average ASHP cost based on 2465 cost submittals. http://www.homeadvisor.com/cost/heating-and-cooling/install-a-heat-pump/

B.3.4.6. Future Data Collection Needs

As with Central Air Conditioning, the cooling side of this measure should be considered for supplementary data collection pertaining to runtime and peak coincidence in three years (PY9, program year 2019-2020).

If heat pump replacement and tune-up ever exceed 1% of program kWh savings, it is recommended to conduct a metering study to validate $EFLH_h$ estimates for heating season savings.

B.3.5. Ductless Heat Pump

B.3.5.1. Measure Description

This measure involves the installation of ductless mini-split heat pumps (DMSHP). These systems have increased savings over efficient air source heat pumps as they use less fan energy to move heat and cooled air and don't incur distribution losses.

B.3.5.2. Baseline and Efficiency Standards[133]

For new construction (NC) and ROB projects, the cooling baseline is 14 SEER and 8.0 HSPF, consistent with the current federal minimum standard[134]. Due to the high cost of this equipment, all projects are assumed to be replacement on burnout or new construction.

A DMSHP must be a high-efficiency, variable-capacity system that exceeds program minimum efficiency requirements. Qualified systems will typically have an inverter-driven DC motor.

Heat Pump equipment shall be properly sized to the dwelling, based on ASHRAE or ACCA Manual J standards. Manufacturer data sheets on installed air conditioning equipment or the AHRI reference number must be provided to the utility. The installed central air conditioning equipment must be AHRI certified.

Table 53: Heat Pump – Baseline and Efficiency Levels

	SEER	***EER***	***HSPF***
New Construction and Normal Replacement	14	11.8	8.2 (split) 8.0 (packaged)
Early Replacement – Heat Pump	13	11.2	7.7 (split & packaged)

B.3.5.3. Estimated Useful Life (EUL)

The average lifetime of this measure is 18 years.[135]

[134] DOE minimum efficiency standard for residential air conditioners/heat pumps. www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75.

[135] Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, GDS Associates, Inc., June 2007

B.3.5.4. Deemed Savings Values

Savings are calculated in the same manner as for Heat Pump Replacement. See Section B.3.3.2. According to the current AHRI database[136], the average efficiency of ENERGY STAR-rated ductless units that are currently in production is as follows:

- SEER: 21.17
- EER: 12.79
- HSPF: 10.43

The average capacity of these units is 2.28 tons.

The resulting average unit energy savings for a ductless mini-split are detailed in the table below. This is per-unit installed in a residence; a retrofit may constitute installation of multiple units, and if so the calculation is performed separately for each and the savings added.

Table 54: Ductless Mini-Split Average Savings

	kWh Per Ton	***kW per Ton***	***Average Tons***	***kWh per Unit***	***kW per Unit***
New Construction and Normal Replacement	825	.0606	2.28	1,881	.1382
Early Replacement – Heat Pump	1,039	.1025	2.28	2,370	.2337

B.3.5.5. Incremental Cost

The incremental cost should use the full installed cost, minus an assumed installation cost of baseline equipment. The baseline cost is $1,381 per ton for a minimum-efficient air source heat pump[137].

B.3.5.6. Future Data Collection Needs

As with Central Air Conditioning, the cooling side of this measure should be considered for supplementary data collection pertaining to runtime and peak coincidence in three years (PY9, program year 2019-2020).

[136] https://www.ahridirectory.org/ahridirectory/pages/vsmshp/cee/defaultSearch.aspx

[137] Based on data provided on Home Advisor website, providing national average ASHP cost based on 2465 cost submittals. http://www.homeadvisor.com/cost/heating-and-cooling/install-a-heat-pump/

If heat pump replacement and tune-up ever exceed 1% of program kWh savings, it is recommended to conduct a metering study to validate $EFLH_h$ estimates for heating season savings.

Further, this measure represents significant savings potential for the residential HVAC market. ADM advises that a market assessment be completed to provide strategic data to ENO, their implementers, and other stakeholders to support future marketing of this measure.

B.3.6. Central Air Conditioner Tune-Up

B.3.6.1. Measure Description

This measure applies to central air conditioners and heat pumps. An AC tune-up, in general terms, involves checking, adjusting and resetting the equipment to factory conditions, such that it operates closer to the performance level of a new unit. This measure applies to all residential applications.

For this measure, the service technician must complete the following tasks according to industry best practices:

- Air Conditioner Inspection and Tune-Up Checklist[138]
- Inspect and clean condenser, evaporator coils, and blower.
- Inspect refrigerant level and adjust to manufacturer specifications.
- Measure the static pressure across the cooling coil to verify adequate system airflow and adjust to manufacturer specifications.
- Inspect, clean, or change air filters.
- Calibrate thermostat on/off set points based on building occupancy.
- Tighten all electrical connections, and measure voltage and current on motors.
- Lubricate all moving parts, including motor and fan bearings.
- Inspect and clean the condensate drain.
- Inspect controls of the system to ensure proper and safe operation. Check the starting cycle of the equipment to assure the system starts, operates, and shuts off properly.
- Provide documentation showing completion of the above checklist to the utility or the utility's representative.

B.3.6.2. Baseline and Efficiency Standards

The baseline is a system with demonstrated imbalances of refrigerant charge.

After the tune-up, the equipment must meet airflow and refrigerant charge requirements. To ensure the greatest savings when conducting tune-up services, the eligibility minimum requirement for airflow is the manufacturer specified design flow rate, or 350 CFM/ton, if unknown. Also, the refrigerant charge must be within +/- 3 degrees of target

[138] Based on ENERGY STAR® HVAC Maintenance Checklist. www.energystar.gov/index.cfm?c=heat_cool.pr_maintenance

sub-cooling for units with thermal expansion valves (TXV) and +/- 5 degrees of target super heat for units with fixed orifices or a capillary.

The efficiency standard, or efficiency after the tune-up, is assumed to be the manufacturer specified energy efficiency ratio (EER) of the existing central air conditioner or heat pump. The efficiency improvement resulting from the refrigerant charge adjustment depends on the pre-adjustment refrigerant charge.

B.3.6.3. Estimated Useful Life (EUL)

The average lifetime of this measure is 10 years, according to CA DEER 2014.

B.3.6.4. Deemed Savings Values

The methodologies in this chapter detail the approach program staff should take to capture data needed to calculate savings from AC tune-ups. However, this data may not always be readily available or measurable. The values in Table 55 reflect the per-ton and per-unit averages from the PY6 evaluation and should be used when test data cannot be collected.

Table 55: AC Tune-Up Deemed kWh

System Type	kWh/Ton	kW/Ton	Average Tons	kWh	kW
Central AC	277	.0985	3.31	917	.326
Central Heat Pump	373	.0985	3.31	1,235	.326

B.3.6.5. Deemed Savings Calculations

There are two ways in which deemed savings can be calculated for this measure:

1) Test-in and test-out efficiency; or
2) Application of a stipulated reduction in annual use.

B.3.6.5.1. Test-in and Test-out Efficiency

$$kW_{Savings} = CAP_c \times 1{,}000\, {}^{W}\!/_{kW} \times \left(\frac{1}{EER_{pre}} - \frac{1}{EER_{post}}\right) \times \%CF$$

$$kWh_{Savings\_Cooling} = CAP_c \times 1{,}000\, {}^{W}\!/_{kW} \times \left(\frac{1}{EER_{pre}} - \frac{1}{EER_{post}}\right) \times EFLH_C$$

Where,

CAP_c = Cooling capacity (in BTU)

EER_{pre} = Efficiency of the equipment prior to tune-up

EER_{post}= Nameplate efficiency of the existing equipment

EFLHc = Equivalent Full-Load Cooling Hours

EFLHh = Equivalent Full-Load Heating Hours

%CF = Peak Coincidence Factor

B.3.6.5.2. Baseline Efficiency

Baseline efficiency is calculated as:

$$EER_{pre} = (1 - EL) \times EER_{post}$$

EL is the Efficiency Loss based on the current refrigerant charge level. The EL values are summarized in Table 56 and Table 57.

Table 56: Efficiency Loss by Refrigerant Charge Level (Fixed Orifice)

% Charged	*EL*
≤70	.37
75	.29
80	.20
85	.15
90	.10
95	.05
100	0
≥120	.03

Table 57: Efficiency Loss by Refrigerant Charge Level (TXV)

% Charged	*EL*
≤70	.12
75	.09
80	.07
85	.06
90	.05
95	.03
100	.00
≥120	.04

B.3.6.5.3. Equivalent Full-Load Hours

Equivalent Full-Load Cooling Hours (EFLHc) measures the total annual runtime of HVAC equipment. To support development of this value, the usage of 68 HVAC systems in New Orleans was metered. This runtime was then normalized to correspond to Typical Meteorological Year ("TMY") weather data for New Orleans.

The resulting EFLHc is 1,637.

B.3.6.5.4. Peak Coincidence Factor

The Peak Coincidence Factor is defined as the percent time during the ENO peak period where the residential central air conditioner is operational. Peak hours were defined as:

- Weekdays
- Non-holidays
- 4:00-5:00 PM
- Average ambient temperature exceeding 90 degrees Fahrenheit.

The average central AC runtime during qualified hours was 77%. This peak coincidence factor is applied to calculate peak kW demand reductions from this measure.

B.3.6.5.5. % Off Annual Use

Alternatively, program administrators may elect to claim savings based off of a percent reduction in annual use.

$$kW_{Savings} = CAP_c \times 1{,}000\, {}^{W}\!/_{kW} \times \left(\frac{1}{EER_{pre}}\right) \times \%CF\%Reduction$$

$$kWh_{Savings} = CAP_c \times 1{,}000\, {}^{W}\!/_{kW} \times \left(\frac{1}{EER_{pre}}\right) \times EFLH_C \times \%Reduction$$

In this, EERpre is assumed to be 9.52[139]. %Reduction is 10.1%. This value is derived from PY5 EM&V of the Residential Heating & Cooling Program.

B.3.6.5.6. Uncertainty Analysis

The uncertainties associated with the two key parameters collected in EM&V are as follows:

- EFLHc: ±7.81%
- % Coincidence: ±2.11%

B.3.6.6. Incremental cost

The incremental cost of an AC Tune-Up is $175[140].

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[139] 11.8 EER nameplate with 85% charge

B.3.6.7. Future Studies

Due to low realization of this measure in PY5 M&V, it is suggested that this measure be evaluated each year until such time that program plan numbers align with M&V results.

The incremental cost value is very sensitive to labor costs, and as such a New Orleans-specific cost study should be conducted to revise this value.

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[140] Illinois TRM

B.3.7. Duct Sealing

B.3.7.1. Measure Description

This measure is comprised of performing duct sealing using mastic sealant or metal tape to the distribution system of homes with a central air conditioning system. Materials should be long-lasting materials such as UL 181A or UL 181 B-approved foil tape. Fabric-based duct tape is not allowed.

In calculating savings for this measure, program administrators are to use the leakage-to-unconditioned space metric, entailing a blower-door subtraction test method. this technique is described in detail on p.44 of the Energy Conservatory Blower Door Manual; which can be found on the Energy Conservatory website[141].

B.3.7.2. Baseline and Efficiency Standards

The baseline for this measure is unsealed ductwork, with a maximum pre-installation leakage rate of 40% of total fan flow[142]. This cap is imposed because interior temperature in homes that exceed 40 percent total leakage would be above the thermally acceptable comfort levels published by ASHRAE in its 2009 Fundamentals publication. Historically, homeowners would remedy a situation in such a state of disrepair, and out of concern for the validity of baseline test measurements performed by duct sealing contractors and to ensure that the savings are program attributable, program administrators must cap baseline leakage at 40% of fan flow, and report the extent to which contractors' baseline leakage measurements exceed this fan flow.

B.3.7.3. Estimated Useful Life (EUL)

According to DEER 2014, the Estimated Useful Life for duct sealing is 18 years.

B.3.7.1. Deemed Savings Values

The methodologies in this chapter detail the approach program staff should take to capture data needed to calculate savings from AC tune-ups. However, this data may not always be readily available or measurable. The values in Table 58 reflect the average per-home leakage reduction found in the PY6 evaluation of the Home Performance with Energy Star Program and apply the deemed inputs detailed in B.3.7.2.

[141] As of Oct 2014: http://www.energyconservatory.com/sites/default/files/documents/mod_3-4_dg700_-_new_flow_rings_-_cr_-_tpt_-_no_fr_switch_manual_ce_0.pdf

[142] Total Fan Flow = Cooling Capacity (tons) × 400

Table 58: Duct Sealing Deemed Savings Values

System Type	Average Leakage Reduction	kWh	kW
AC with Gas Heat	307	1,605	.755
Heat Pump	307	2,570	.755
AC with Electric Resistance Heat	307	3,782	.755
Electric Resistance Heat, no AC	307	2,177	.00

B.3.7.2. Deemed Savings Calculations

The following formulas shall be used to calculate deemed savings for duct sealing.

B.3.7.2.1. Cooling Savings

$$kWh_{cooling} = \frac{(DL_{pre} - DL_{post}) \times EFLH_c \times (h_{out}\rho_{out-}h_{in}\rho_{in}) \times 60}{1000 \times SEER}$$

Where,

DL_{pre} = Pre-measurement of leakage to unconditioned space

DL_{post} = Post-measurement of leakage to unconditioned space

$EFLH_c$ = Equivalent Full Load Cooling Hours, 1,637, based on ADM metering of New Orleans homes

H_{out} = Outdoor design enthalpy, 40 BTU/lb.

H_{in} = Indoor design enthalpy, 30 BTU/lb.

P_{out} = Density of outdoor air at 95 deg. F, .0740 lb./ft.^{3}

P_{in} = Density of outdoor air at 95 deg. F, .0756 lb./ft.^{3}

SEER = Seasonal Efficiency Rating of existing systems (BTU/W*hr.). Default of 13

1,000 = W/kW conversion factor

60 = Minutes/hour conversion factor

The default of 13 SEER is based on the inspection of 182 program participants in Home Performance with ENERGY STAR and Assisted Home Performance with ENRGY STAR. These 182 participants had 135 unique model numbers, with an average SEER of 12.98. The minimum code prior to 2015 was 13 SEER, and given how close the mean value is to that code value, we recommend a default SEER of 13.

B.3.7.2.2. Heating Savings (Heat Pump)

Heating savings are calculated as:

$$kWh_{Heating,Heat\ Pump} = \frac{\left(DL_{pre} - DL_{post}\right) \times HDD \times (h_{out}\rho_{out-}h_{in}\rho_{in}) \times 60 \times 24 \times .018}{1000 \times HSPF}$$

Where,

DL_{pre} = Pre-measurement of leakage to unconditioned space

DL_{post} = Post-measurement of leakage to unconditioned space

HDD = Heating degree days for New Orleans, based on TMY3 data: 1,349

H_{out} = Outdoor design enthalpy, 40 BTU/lb.

H_{in} = Indoor design enthalpy, 30 BTU/lb.

P_{out} = Density of outdoor air at 95 deg. F, .0740 $lb./ft.^3$

P_{in} = Density of outdoor air at 95 deg. F, .0756 $lb./ft.^3$

HSPF = Heating Season Performance Factor of existing systems (BTU/W*hr.). Default of 7.7

1,000 = W/kW conversion factor

60 = Minutes/Hour conversion factor

24 = Hours/Day conversion factor

.018 = Volumetric heat capacity of air ($BTU/Ft.^3$ *deg. F)

The default HSPF of 7.7 is based on our findings with inspections of residential air conditioners. The amount of heat pumps was too limited to develop a statistically valid average HSPF. However, of the 182 participants visited in EM&V of Home Performance with ENERGYS STAR and Assisted Home Performance with ENERGYS STAR found an average SEER of 12.98. Given this, ADM concluded that the average unit to receive duct sealing was installed in the 2006-2015 code period, which had a minimum requirement of 7.7 HSPF.

B.3.7.2.3. Heating Savings (Electric Resistance)

Heating savings are calculated as:

$$kWh_{Heating,Heat\ Pump} = \frac{\left(DL_{pre} - DL_{post}\right) \times HDD \times (h_{out}\rho_{out-}h_{in}\rho_{in}) \times 60 \times 24 \times .018}{3{,}412}$$

Where,

DL_{pre} = Pre-measurement of leakage to unconditioned space

DL_{post} = Post-measurement of leakage to unconditioned space

HDD = Heating degree days for New Orleans, based on TMY3 data: 1,349

H_{out} = Outdoor design enthalpy, 40 BTU/lb.

H_{in} = Indoor design enthalpy, 30 BTU/lb.

P_{out} = Density of outdoor air at 95 deg. F, .0740 lb./ft.^{3}

P_{in} = Density of outdoor air at 95 deg. F, .0756 lb./ft.^{3}

3,412 = Conversion of BTU/kWh

60 = Minutes/Hour conversion factor

24 = Hours/Day conversation factor

.018 = Volumetric heat capacity of air (BTU/Ft.^{3} *deg. F)

B.3.7.2.4. Demand Savings (Cooling)

Demand savings are calculated by applying peak coincidence to the Cooling kWh savings. If the residence does not have central air conditioning (i.e., the ductwork is used only for heating distribution) then demand savings are 0.

$$kW = \frac{kWh_{cooling}}{EFLH_c} \times Coincidence\%$$

Where,

$kWh_{cooling}$ = Calculated kWh cooling savings

$EFLH_c$ = Equivalent Full Load Cooling Hours, 1,637, based on ADM metering of New Orleans homes

Coincidence% = 77%, calculated based on ADM metering of New Orleans homes.

B.3.7.2.5. Uncertainty Analysis

The uncertainties associated with the two key parameters collected in EM&V are as follows:

- EFLHc: ±7.81%
- % Coincidence: ±2.11%

B.3.7.3. Incremental cost

The incremental cost of this measure is the full installed cost. If this is not available than the PY6 average cost of $368 may be used instead.

B.3.7.4. Future Studies

This is a high impact measure, regularly constituting a large percent of Energy Smart program savings. This measure also has significant interaction with other measures (AC Tune-Up, building envelope improvements).

In PY7 or PY8, a measure interaction study between Duct Sealing, AC Tune-Up, and high impact Building Envelope improvements should be completed to provide adjustment factors for multiple-measure installation.

Further, ADM recommends that savings estimates for Duct Sealing be validated with a billing analysis of the past three years of program participants.

B.4. Envelope Measures

B.4.1. Attic Knee Wall Insulation

B.4.1.1. Measure Description

This measure involves adding attic knee wall insulation to un-insulated knee wall areas in residential dwellings of existing construction. A wall with an insulation value of R-0 has no insulation, but does have a nominal wall R-value made up of interior and exterior wall materials, air film and wood studs. This measure applies to all residential applications.

B.4.1.2. Baseline and Efficiency Standards

This measure applies to existing construction only.

Table 59: Attic Knee Wall Insulation – Baseline and Efficiency Standards

Baseline	***Efficiency Standard***
Uninsulated knee wall	Minimum R-19 or R-30

B.4.1.3. Estimated Useful Life (EUL)

The average lifetime of this measure is 20 years, based on NEAT v. 8.6.

B.4.1.4. Deemed Savings

This measure has not been included in Energy Smart programs to-date. To provide an estimate of per-project savings, we use PY6 average project size for attic insulation. The average project in PY6 Home Performance with Energy Star was 1,633 square feet. For this estimation, we assume a square attic (40.41 feet per wall side). The assumed knee-wall height is three feet. The resulting surface area to be insulated is:

$$Knee - Wall\ Area = 40.41_{Wall\ length} \times 4_{\#walls} \times 3_{Wall\ height} = 496.92\ ft.^2$$

Table 60: Knee Wall Insulation – Deemed Savings Values Per Residence

Ceiling Insulation Base R-Value	**AC/Gas Heat kWh**	**AC/Electric Resistance kWh**	**Heat Pump kWh**	**AC Peak Savings (kW)**
	(/ sq. ft.)	**(/ sq. ft.)**	**(/ sq. ft.)**	**(/ sq. ft.)**
R-19	1,789	487	3,328	1,155
R-30	2,225	302	3,747	1,297

.

Table 61: Knee Wall Insulation – Deemed Savings Values Per Square Foot

Ceiling Insulation Base R-Value	**AC/Gas Heat kWh**	**AC/Electric Resistance kWh**	**Heat Pump kWh**	**AC Peak Savings (kW)**
	(/ sq. ft.)	**(/ sq. ft.)**	**(/ sq. ft.)**	**(/ sq. ft.)**
R-19	3.600	6.698	2.324	0.000
R-30	4.477	7.540	2.610	0.000

B.4.1.5. Calculation of Deemed Savings

The deemed savings are dependent on the R-value of the attic knee wall, pre- and post-retrofit.

BEopt™ was used to estimate energy savings for a series of models using the DOE EnergyPlus simulation engine. Since attic knee wall insulation savings are sensitive to weather, available TMY3 weather data specific to each of the four Arkansas weather regions was used for the analysis. The prototype home characteristics used in the BEopt™ building model are outlined in Appendix A.

B.4.1.6. Incremental Cost

The incremental cost for this measure is the total cost. The cost is $0.035 per sq. ft. per "R" unit of insulation[143]. For the average project size of 496.92 square feet, the resulting cost is:

- R-19: $330
- R-49: $522

B.4.1.7. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using default values based on simulation results. If this measure is added to Energy Smart programs and exceeds 1% of residential savings, then the simulation model should be updated to align with the billed use of customers that install the measure.

[143] Public Service Company of New Mexico Commercial & Industrial Incentive Program Work Papers, 2011.

B.4.2. Ceiling Insulation

B.4.2.1. Measure Description

This measure requires adding ceiling insulation above a conditioned area in a residential dwelling of existing construction to a minimum ceiling insulation value of R-38. Savings are also estimated for an optional final insulation level of R-49. This measure applies to all residential applications.

This measure pertains to ceiling insulation only (attic floor). There is a separate measure (Measure 2.2.5) for roof deck insulation.

B.4.2.2. Baseline and Efficiency Standards

In existing construction, ceiling insulation levels vary greatly, depending on the age of the home, type of insulation, and attic space utilization (such as using the attic for storage and HVAC equipment). The average pre-retrofit insulation level of the treated area will be determined and documented by the insulation contractor according to the ranges in Table 77. Degradation due to age and condition of the existing insulation will need to be considered by the insulation contractor. Care must be exercised in differentiating between an existing R-value in the 0-1 range versus in the 2-4 range as the resulting savings are very sensitive in the lower ranges.

The eligibility standard for this measure (minimum final R-value) is R-30, as specified in IECC 2009. Savings are also provided for R-49 as an optional final R-value, as specified for IECC climate zone 4 beginning in IECC 2012.

Table 62: Ceiling Insulation – Baseline and Efficiency Standards

Baseline	***Efficiency Standard***
R-0 to R-1	R-38 or R-49
R-2 to R-4	
R-5 to R-8	
R-9 to R-14	
R-15 to R-22	

B.4.2.3. Estimated Useful Life (EUL)

The average lifetime of this measure is 20 years, according to DEER 2014.

B.4.2.4. Deemed Savings Values

Deemed savings values have been calculated for each of the four weather zones. The deemed savings are based on the R-value of the ceiling insulation pre-retrofit and a combined post-retrofit R-value (R-values of the existing insulation and the insulation being added) of at least R-38. Savings are also provided for R-49, and linear interpolation may be used to claim savings for final R-values between R-38 and R-49.

Note that the savings per square foot is a factor to be multiplied by the square footage of the ceiling area over a conditioned space that is being insulated.

For deemed savings for installation between the range of R-38 to R-49, linear interpolation can be used to determine the value that can be claimed as savings.

When providing per-residence estimates, we have included the following parameters from the PY6 Home Performance With Energy Star Program:

- Average project size: 1,633 square feet
- Average baseline: R - 0.85[144]

Table 63: Deemed Savings for R-30 – Per-Residence

AC/Gas Heat kWh	AC/Electric Resistance kWh	Heat Pump kWh	AC Peak Savings (kW)
(/ sq. ft.)	**(/ sq. ft.)**	**(/ sq. ft.)**	**(/ sq. ft.)**
3,830	9,682	5,949	2.613

Table 64: Deemed Savings for R-38 – Per-Residence

AC/Gas Heat kWh	AC/Electric Resistance kWh	Heat Pump kWh	AC Peak Savings (kW)
(/ sq. ft.)	**(/ sq. ft.)**	**(/ sq. ft.)**	**(/ sq. ft.)**
3,903	9,867	6,063	2.613

Table 65: Deemed Savings for R-49 – Per-Residence

144 83% of projects in PY6 had R-0 baseline. Contractors in the HPwES Program have demonstrated that they do not install insulation on lower-return projects (such as R-9 or above)

AC/Gas Heat kWh	AC/Electric Resistance kWh	Heat Pump kWh	AC Peak Savings (kW)
(/ sq. ft.)	(/ sq. ft.)	(/ sq. ft.)	(/ sq. ft.)
3,964	10,024	6,159	2.613

Table 66: Deemed Savings for R-30 – Per ft.²

Ceiling Insulation Base R-Value	AC/Gas Heat kWh	AC/Electric Resistance kWh	Heat Pump kWh	AC Peak Savings (kW)
	(/ sq. ft.)	(/ sq. ft.)	(/ sq. ft.)	(/ sq. ft.)
0 to 4	2.3451	5.9291	3.6430	0.0016
5 to 8	1.1392	3.1249	1.8749	0.0005
9 to 14	0.6446	1.8343	1.1072	0.0003
15 to 22	0.3402	1.0027	.6018	0.0001

Table 67: Deemed Savings for R-38 – Per ft.²

Ceiling Insulation Base R-Value	AC/Gas Heat kWh	AC/Electric Resistance kWh	Heat Pump kWh	AC Peak Savings (kW)
	(/ sq. ft.)	(/ sq. ft.)	(/ sq. ft.)	(/ sq. ft.)
0 to 4	2.3900	6.044	3.7127	0.0016
5 to 8	1.2055	3.3070	1.9841	0.0006
9 to 14	0.7290	2.0743	1.2521	0.0004
15 to 22	0.4554	1.3423	0.8057	0.0002

Table 68: Deemed Savings for R-49 – Per ft.²

Ceiling Insulation Base R-Value	AC/Gas Heat kWh	AC/Electric Resistance kWh	Heat Pump kWh	AC Peak Savings (kW)
	(/ sq. ft.)	(/ sq. ft.)	(/ sq. ft.)	(/ sq. ft.)
0 to 4	2.4277	6.1381	3.7714	0.0016
5 to 8	1.2613	3.4600	2.0760	0.0006
9 to 14	0.8000	2.2764	1.3741	0.0004
15 to 22	0.5524	1.6282	0.9773	0.0002

B.4.2.5. Calculation of Deemed Savings

BEopt™ was used to estimate energy savings for a series of models using the DOE EnergyPlus simulation engine; available TMY3 weather data specific to each of the four Arkansas weather regions were used for the analysis. The prototype home characteristics used in the BEopt™ building model are outlined in Appendix A.

B.4.2.6. Incremental Cost

The incremental cost for this measure is the total cost. The cost is $0.035 per sq. ft. per "R" unit of insulation[145]. For the average project size of 1,633 square feet, the resulting cost is:

- R-30: $1,715
- R-38: $2,172
- R-49: $2,801

B.4.2.7. Future Studies

This measure is a High Impact Measure, having constituted 8.7% of PY6 program savings. To-date, the evaluations have not conducted significant primary research on this measure due to the focusing of EM&V budget on Residential Lighting and Residential HVAC studies.

This measure should have its simulation model recalibrated to the billed use of the past three years of program participants. Further, the next EM&V study should measure the level of interaction between this measure and other significant building envelope and HVAC improvements (duct sealing, air sealing, AC tune-up, etc.).

[145] Public Service Company of New Mexico Commercial & Industrial Incentive Program Work Papers, 2011.

If there is adequate participation, the assumed default square foot value should be revised.

B.4.3. Wall Insulation

B.4.3.1. Measure Description

This measure consists of adding wall insulation in the wall cavity in residential dwellings of existing construction. This measure applies to all residential applications.

B.4.3.2. Baseline and Efficiency Standards

In order to qualify for this measure, there must be no existing wall cavity insulation. Post-retrofit condition will be a wall cavity filled with either fiberglass or cellulose insulation (R-13 nominal value), open cell insulation (R-13 nominal value), or closed cell foam insulation (R-23 nominal value). Each type of insulation's nominal R-value depends on a full thickness application within the cavity of a wall with 2x4 inch studs.

Table 69: Wall Insulation – Baseline and Efficiency Standards

Baseline	**Efficiency Standard (Nominal R-Values)**	
Uninsulated wall cavity	Fiberglass/Cellulose	R-13
	Open Cell Foam	R-13
	Closed Cell Foam	R-23

B.4.3.3. Estimated Useful Life (EUL)

The average lifetime of this measure is 20 years, according to DEER 2014.

B.4.3.4. Deemed Savings

The savings per square foot is a factor to be multiplied by the square footage of the net wall area insulated. Wall area must be part of the thermal envelope of the home, and shall not include window or door area.

Deemed savings for R-13 can be achieved with either fiberglass, cellulose, or open cell foam insulation. Deemed savings for R-23 is only applicable to closed cell insulation. The R-value represents the nominal value of the cavity insulation and not the R-value of the wall assembly.

For deemed savings for installation between the range of R-13 to R-23, linear interpolation can be used to determine the value that can be claimed as savings.

To calculate savings per-residence, the following assumptions are used:

- Average square feet of insulation: 1,501[146]

Table 70: Wall Insulation – Deemed Savings Values Per-Residence

Ceiling Insulation Base R-Value	kWh Savings / sq. ft.		kW Peak Savings / sq. ft.	
	R-13	R-23	R-13	R-23
Electric Cooling with Gas Heat	0.78286	0.82574	0.00033	0.00060
Electric Cooling with Electric Resistance Heat	3.33772	3.74885	0.00033	0.00060
Electric Cooling with Electric Heat Pump	1.05252	1.13064	0.00033	0.00051

Table 71: Wall Insulation – Deemed Savings Values Per-Ft.^{2}

Ceiling Insulation Base R-Value	kWh Savings / sq. ft.		kW Peak Savings / sq. ft.	
	R-13	R-23	R-13	R-23
Electric Cooling with Gas Heat	0.78286	0.82574	0.00033	0.00060
Electric Cooling with Electric Resistance Heat	3.33772	3.74885	0.00033	0.00060
Electric Cooling with Electric Heat Pump	1.05252	1.13064	0.00033	0.00051

B.4.3.5. Calculation if Deemed Savings

Deemed savings values have been calculated for each of the four weather zones. The deemed savings are dependent on the R-value of the wall pre- and post-retrofit. BEopt™ was used to estimate energy savings for a series of models using the DOE EnergyPlus simulation engine. Since wall insulation savings are sensitive to weather, available TMY3 weather data specific to each of the four Arkansas weather regions were used for the analysis. The prototype home characteristics used in the BEopt™ building model are outlined in Appendix A.

[146] ENERGY STAR guidance. https://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/Savings_and_Cost_Estimate_Summary.pdf

B.4.3.6. Incremental Cost

The incremental cost of this measure is equal to the full installed cost. If this is not available, use $.92 per square foot.[147]. For the average project size of 1,501 square feet, this results in an incremental cost of $1,381.

B.4.3.1. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using default values based on simulation results. If this measure is added to Energy Smart programs and exceeds 1% of residential savings, then the simulation model should be updated to align with the billed use of customers that install the measure.

If there is adequate participation, the assumed default square foot value should be revised.

[147] Midpoint value for floor insulation specified on Home Advisor. http://www.homeadvisor.com/cost/insulation/

B.4.4. Floor Insulation

B.4.4.1. Measure Description

This measure presents two eligible scenarios for retrofitting a crawl space underneath an uninsulated floor[148]:

1. Insulating the underside of the floor (above the vented crawl space), where the floor previously had no insulation
2. "Encapsulating" the crawl space – sealing and insulating the vented perimeter skirt or stem wall between the ground (finished grade) and the first floor of the house, leaving the underside of the first floor structure uninsulated

This measure applies to all residential applications.

B.4.4.2. Baseline and Efficiency Standards

The baseline is considered to be a house with pier and beam construction, no insulation under the floor of the conditioned space, and a vented crawl space. In order to qualify for deemed savings, either the floor can be insulated to a minimum of R-19 or the crawl space can be encapsulated as described below. Deemed savings are provided for each option.

- Option 1 – Insulating the underside of the floor to a minimum of R-19.
- Option 2 – Encapsulating the crawl space: The crawl space perimeter skirt or stem walls are sealed in a sound and durable manner and the ground (floor of the crawl space) is sealed with a heavy plastic vapor barrier. The skirt or stem wall interior surfaces are insulated to R-13 (minimum) with closed cell foam[149]. The underside of the floor above the crawlspace is left uninsulated. A small flow of conditioned air to the crawl space is recommended to moderate humidity levels[150].

Occupational Safety and Health Administration (OSHA) standards and applicable versions of the IECC and IRC codes will be pertinent to the installation. Note that this will include ensuring that any oil or gas-fueled furnaces or water heaters located in the

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[148] U.S. DOE publication *"Building America Best Practices Series, Vol 17, "Insulation*" found at http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/insulation_guide.pdf (accessed 7-8-15) has extensive building science and code conformance information regarding insulating floors as well as sealing and insulating crawl spaces.

[149] IECC 2012, Table R402.1

[150] U.S. DOE publication "*Building America Best Practices Series, Vol 17, "Insulation*" found at http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/insulation_guide.pdf (accessed 7-8-15), p. 58, 1 cfm per every 50 sq. ft. of floor area.

crawlspace be provided with dedicated combustion air supply or be sealed-combustion units equipped with a powered combustion system.[151]

Table 72: Floor Insulation – Baseline and Efficiency Standards

Baseline	*Efficiency Standard*
No insulation under floor	(1) R-19 installed under floor, OR (2) Encapsulated crawl space with air-sealed perimeter having R-13 insulation on the interior side, no floor insulation under the floor above, and moisture-sealed grade under the crawl space

B.4.4.3. Estimated Useful Life (EUL)

The average lifetime of this measure is 20 years, according to DEER 2014.

B.4.4.4. Deemed Savings Values

The deemed savings values listed below are per square foot of first level floor area above the crawl space.

For the per-residence savings, we assume the same square feet as attic insulation (1,633 ft.^{2}), due to a lack of participation in this measure. This is to be updated when there is adequate participation to support an estimate.

Table 73: R-19 Floor Insulation – Deemed Savings Values Per-Residence

Equipment Type	kWh Savings / residence	kW Peak Savings / residence
Electric Cooling with Gas Heat	-393.226	Negligible
Electric Cooling with Electric Resistance Heat	108.5945	n/a
Electric Cooling with Electric Heat Pump	807.5185	Negligible

Table 74: R-19 Floor Insulation – Deemed Savings Values Per-Ft.^{2}

Equipment Type	kWh Savings / sq. ft.	kW Peak Savings / sq. ft.
Electric Cooling with Gas Heat	-0.2408	Negligible

[151] Ibid (p. 59).

Electric Cooling with Electric Resistance Heat	0.4945	Negligible
Electric Cooling with Electric Heat Pump	0.0952	Negligible

B.4.4.5. Calculation of Deemed Savings

Deemed savings values have been calculated for each of the four weather zones. BEopt™ was used to estimate energy savings for both options using the same base case model (uninsulated floor) and the DOE EnergyPlus simulation engine. Savings are sensitive to weather; therefore, available TMY3 weather data specific to New Orleans used for the analysis. The prototype home characteristics used in the BEopt™ building model are outlined in Appendix A.

B.4.4.6. Incremental Cost

The incremental cost of this measure is equal to the full installed cost.

B.4.4.7. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using default values based on simulation results. If this measure is added to Energy Smart programs and exceeds 1% of residential savings, then the simulation model should be updated to align with the billed use of customers that install the measure.

If there is adequate participation, the assumed default square foot value should be revised.

B.4.5. Window Film

B.4.5.1. Measure Description

This measure consists of adding solar film to east and west facing windows. This measure applies to all residential applications.

B.4.5.2. Baseline and Efficiency Standards

This measure is applicable to existing homes only. Low E windows and tinted windows are not applicable for this measure. In order to qualify for deemed savings, solar film should be applied to east and west facing glass.

Table 75: Window Film – Baseline and Efficiency Standards

Baseline	***Efficiency Standard***
Single- or double-pane window with no existing solar films, solar screens, or low-e coating	Solar Film with SHGC <0.50

B.4.5.3. Estimated Useful Life (EUL)

The average lifetime of this measure is 10 years, according to DEER 2014.

B.4.5.4. Deemed Savings Values

Please note that the savings per square foot is a factor to be multiplied by the square footage of the window area to which the films are being added.

For the per-residence values, we assume 330 total window square feet[152].

[152] ENERGY STAR guidance. https://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/Savings_and_Cost_Estimate_Summary.pdf

Table 76: Window Film – Deemed Savings Values Per-Residence

Existing Window Pane Type	AC/Gas Heat kWh	AC/Electric Resistance kWh	Heat Pump kWh	AC Peak Savings (kW)
	(/ residence)	(/ residence)	(/ residence)	(/ residence)
Single Pane	1,391	-218	531	0.33
Double Pane	813	-75	273	0.33

Table 77: Window Film – Deemed Savings Values Per-Ft.^{2}

Existing Window Pane Type	AC/Gas Heat kWh	AC/Electric Resistance kWh	Heat Pump kWh	AC Peak Savings (kW)
	(/ sq. ft.)	(/ sq. ft.)	(/ sq. ft.)	(/ sq. ft.)
Single Pane	4.216	-0.661	1.610	0.001
Double Pane	2.465	-0.226	0.826	0.001

B.4.5.5. Calculation of Deemed Savings

Deemed savings values have been calculated for each of the four weather zones. The deemed savings are dependent on the SHGC of pre- and post-retrofit glazing. BEopt™ was used to estimate energy savings for a series of models using the DOE EnergyPlus simulation engine. Since window film savings are sensitive to weather, available TMY3 weather data specific to New Orleans was ere used for the analysis. The prototype home characteristics used in the BEopt building model are outlined in Appendix A.

B.4.5.6. Incremental Cost

The incremental cost of this measure is equal to the full installed cost. If this is not available, the default cost is:

- $2.00 per square foot[153]
- $660 per residence

[153] Energize Connecticut cost documentation. http://www.uinet.com/wps/wcm/connect/193bba80476e1bc19d6c9d02c80795ac/FINAL-C0118-2017-UI-CI-Incentive-Matrix-Gas-Caps-Rev.+02.17.pdf?MOD=AJPERES&CACHEID=193bba80476e1bc19d6c9d02c80795ac

B.4.5.1. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using default values based on simulation results. If this measure is added to Energy Smart programs and exceeds 1% of residential savings, then the simulation model should be updated to align with the billed use of customers that install the measure.

If there is adequate participation, the assumed default square foot value should be revised.

B.4.6. Air Infiltration

B.4.6.1. Measure Description

This measure reduces air infiltration into the residence, using pre- and post-treatment blower door air pressure readings to quantify the air leakage reduction. There is no post-retrofit minimum infiltration requirement, however, installations must comply with the prevailing Arkansas mechanical code. This measure applies to all residential applications.

B.4.6.2. Baseline and Efficiency Standards

The baseline for this measure is the existing leakage rate of the residence to be treated. The existing leakage rate should be capped to account for the fact that the deemed savings values per CFM50 leakage reduction are only applicable up to a point where the existing HVAC equipment would run continuously. Beyond that point, energy use will no longer increase linearly with an increase in leakage.

Baseline assumptions used in the development of these deemed savings are based on the *2013 ASHRAE Handbook of Fundamentals, Chapter 16*, which provides typical infiltration rates for residential structures. In a study of low income homes reported in ASHRAE, approximately 95 percent of the home infiltration rates were below 3.0 ACH_{Nat}.[154] Therefore, to avoid incentivizing homes with envelope problems not easily remedied through typical weatherization procedures, or improperly conducted blower door tests, these savings should only be applied starting at a baseline ACH_{Nat} of 3.0 or lower.

To calculate the maximum allowable $CFM_{50,pre}$-value for a particular house, use the following equation:

$$CFM_{50,pre}/ft^2 = \frac{ACH_{Nat,pre} \times h \times N}{60}$$

Where:

$CFM_{50,pre}/_{ft}^2$ = Per square foot pre-installation infiltration rate (CFM50/ft2)

$ACH_{Nat,pre}$ = Maximum pre-installation air change rate (ACH_{Nat}) = 3.0

60 = Constant to convert from minutes to hours

h = Ceiling height (ft.) = 8.5 (default)155

N = N factor (Table 78:)

[154] 2013 ASHRAE *Handbook of Fundamentals, Chapter 16,* pp. 16.18, Figure 12.

[155] Typical ceiling height of 8 feet adjusted to account for greater ceiling heights in some areas of a typical residence.

Table 78: Air Infiltration – N Factor [156]

	Number of Stories		
Wind Shielding	**Single Story**	**Two Story**	**Three + Story**
Well Shielded	25.8	20.6	18.1
Normal	21.5	17.2	15.1
Exposed	19.4	15.5	13.5

Well Shielded is defined as urban areas with high buildings or sheltered areas, and buildings surrounded by trees, bermed earth, or higher terrain.

Normal is defined as buildings in a residential neighborhood or subdivision setting, with yard space between buildings. Approximately 80-90 percent of houses fall in this category.

Exposed is defined as buildings in an open setting with few buildings or trees around and buildings on top of a hill or ocean front, exposed to winds.

Maximum CFM_{50} per square foot values are available in Table 79. Pre-retrofit leakage rates are limited to fa maximum per square foot value specified in the table, as this generally indicates severe structural damage not repairable by typical infiltration reduction techniques.

Table 79: Pre-Retrofit Infiltration Cap (CFM_{50}/ft^2)

	Number of Stories		
Wind Shielding	**Single Story**	**Two Story**	**Three + Story**
Well Shielded	11.0	8.8	7.7
Normal	9.1	7.3	6.4
Exposed	8.2	6.6	5.7

B.4.6.3. Estimated Useful Life (EUL)

According to DEER 2014, the Estimated Useful Life for air infiltration is 11 years.

156 Krigger, J. & Dorsi, C. 2005, *Residential Energy: Cost Savings and Comfort for Existing Buildings, 4th Edition*. *Version RE. Appendix A-11: Zone 3 Building Tightness Limits*, p. 284., December 20. www.waptac.org/data/files/Website_docs/Technical_Tools/Building%20Tightness%20Limits.pdf.

B.4.6.4. Deemed Savings Values

Programs should calculate savings based on pre- and post-retrofit leakage testing. If this data is not available, default estimates may be applied. The following assumptions based on PY6 evaluation results of the Home Performance with ENERGY STAR Program are used in providing per-residence savings estimates:

- Leakage reduction: 2,045 CFM

Table 80: Air Infiltration Reduction – Deemed Savings Values Per-Residence

Equipment Type	kWh Savings / CFM_{50} (ESF)	kW Savings / CFM_{50} (DSF)
Electric AC with Gas Heat	840	0.6769
Elec. AC with Resistance Heat	2,082	0.6789
Heat Pump	1,474	0.6789

B.4.6.5. Deemed Savings Calculations

The following formulas shall be used to calculate deemed savings for infiltration efficiency improvements. The formulas apply to all building heights and shielding factors.

$$kWh_{savings} = CFM_{50} \times ESF$$

$$kW_{savings} = CFM_{50} \times DSF$$

Where:

CFM_{50} = Air infiltration reduction in Cubic Feet per Minute at 50 pascals, as measured by the difference between pre- and post-installation blower door air leakage tests

ESF = corresponding energy savings factor (Table 81)

DSF = corresponding demand savings factor (Table 81)

Table 81: Air Infiltration Reduction – Deemed Savings Values Per-Ft.^{2}

Equipment Type	kWh Savings / CFM_{50} (ESF)	kW Savings / CFM_{50} (DSF)
Electric AC with Gas Heat	0.4108	0.000331
Elec. AC with Resistance Heat	1.018	0.000332
Heat Pump	0.721	0.000332

B.4.6.6. Calculation of Deemed Savings

BEopt™ was used to estimate energy savings for a series of models using the US DOE EnergyPlus simulation engine. Since infiltration savings are sensitive to weather, available TMY3 weather data specific to New Orleans was used for the analysis. The prototype home characteristics used in the BEopt™ building model are outlined in Appendix A.

The deemed savings are dependent on the pre- and post-CFM_{50} leakage rates of the home and are presented as annual savings / CFM_{50} reduction. A series of model runs was completed in order to establish the relationship between various CFM_{50} leakage rates and heating and cooling energy consumption. The resulting analysis of model outputs was used to create the deemed savings tables of kWh and kW per CFM_{50} of air infiltration reduction.

B.4.6.7. Incremental Cost

The incremental cost of this measure is equal to the full installed cost. If this is not available, a default value of $.25 per square foot of conditioned floor area may be applied[157]. This should use a default of 1,762 square feet, based on PY6 program tracking for the Home Performance with ENERGY STAR Program.

The resulting per-project incremental cost is $441.

[157] ENERGY STAR guidance. https://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/Savings_and_Cost_Estimate_Summary.pdf

B.4.6.8. Future Studies

This measure is a High Impact Measure, having constituted 13.3% of PY6 program savings. To-date, the evaluations have not conducted significant primary research on this measure due to the focusing of EM&V budget on Residential Lighting and Residential HVAC studies.

This measure should have its simulation model recalibrated to the billed use of the past three years of program participants. Further, the next EM&V study should measure the level of interaction between this measure and other significant building envelope and HVAC improvements (duct sealing, ceiling insulation, AC tune-up, etc.).

B.5. Residential Lighting

B.5.1. ENERGY STAR® Compact Fluorescent Lamps (CFLs)

B.5.1.1. Measure Description

This measure provides a method for calculating savings for replacing an incandescent lamp with a standard CFL in residential applications.

B.5.1.2. Baseline

The baseline equipment is assumed to be an incandescent or halogen lamp with adjusted baseline wattages compliant with EISA 2007 regulations dictate higher efficiency baseline lamps.

The first Tier of EISA 2007 regulations were phased in from January 2012 to January 2014. Beginning January 2012, a typical 100W lamp wattage was reduced to comply with a maximum 72W lamp wattage standard for a rated lumen output range of 1,490-2,600 lumens. Beginning January 2013, a typical 75W lamp wattage was reduced to comply with a maximum 53W lamp wattage standard for a rated lumen output range of 1,050-1,489 lumens. Beginning January 2014, typical 60W and 40W lamp wattages were reduced to comply with maximum 43W and 29W lamp wattage standards for rated lumen output ranges of 750-1,049 and 310-749 lumens.

The second Tier of EISA 2007 regulations go into effect beginning January 2020. At that time, general service lamps must comply with a 45 lumen per watt efficacy standard. Since the EUL of some lamps in this measure extend beyond that date, the baseline should be adjusted to the second Tier for any years after 2022.[158]

B.5.1.3. Efficiency Standard

CFLs must be a standard ENERGY STAR® qualified CFL.

Exceptions to the ENERGY STAR® label are allowed for unlisted lamps, fixtures or other lighting-related devices that have been submitted to ENERGY STAR® for approval. If the lamp or fixture does not achieve ENERGY STAR® approval within the AR DSM program year, however, then the lamp or fixture would have to be immediately withdrawn from the program.

[158] First tier EISA compliant halogens have a lifetime of 4 years (3,000 hours at 2.17 hours per day). The last year these lamps are available is 2019, and they will need replacement at the end of 2022. Thus, the new standard must be used after 2022.

B.5.1.4. Estimated Useful Life (EUL)

The average measure life is based upon rated lamp life of the CFL shown in the following table. The measure life assumes an average daily use of 2.25 blended[159] hours for indoor/outdoor applications and applies a 0.688[160] degradation factor to indoor residential CFLs. This table shows the useful life that should be used for the first tier EISA baseline, and the useful life remaining for the increased second tier EISA standard baseline.

Note that the values are in this table are incremented each program year so that the first-tier values do not exceed 2023 minus the program year. For PY7 (calendar year 2017), the first-tier measure life cannot exceed the result of 2023 - 2017, which is equal to 6 years. The remainder of the measure life is applied to the second tier.

Table 82: ENERGY STAR® CFLs – Measure Life[161]

Rated Measure Life (Hours)	First Tier EISA Standard Baseline		Second Tier EISA Standard Baseline	
	CFL Indoor Application – Measure Life (Years)	CFL Outdoor Application – Measure Life (Years)	CFL Indoor Application – Measure Life (Years)	CFL Outdoor Application – Measure Life (Years)
8,000	6	6	1	1
10,000	6	6	3	3
12,000	6	6	4	4
15,000	6	6	7	7

B.5.1.5. Deemed Savings Per Lamp

Table 83 summarizes the unit energy savings for general service lamps in each lumen bin. This assumes retail markdown delivery and an unknown heating and cooling system configuration.

[159] ADM lighting metering, detailed in this chapter.

[160] Average of 0.526 and 0.85. Original 0.526 is from Itron, Hirsch and Associates, and Research Into Action, "Welcome to the Dark Side: The Effect of Switching on CFL Measure Life"2008 ACEEE Summer Study on Energy Efficiency in Buildings, p. 2-146; and 0.85 is from ENERGY STAR® CFL THIRD PARTY TESTING AND VERIFICATION Off-the-Shelf CFL Performance: Batch 3. Figure 27, p. 47.

[161] EUL = Rated Measure Life in Hours * Degradation Factor / (365.25 * Average Hours of Daily Use). Degradation Factor = 0.526 for indoor applications and 1.000 for outdoor applications.

Table 83: ENERGY STAR® CFLs – Deemed Savings Per Lamp

Minimum Lumens	***Maximum Lumens***	***Incandescent Equivalent 1st Tier EISA 2007 (W_{base})***	***CFL Wattage***	***kWh/Lamp***	***kW/Lamp***
310	749	29	10	13.88	0.0029
750	1,049	43	14	21.19	0.0044
1,050	1,489	53	20	24.12	0.0050
1,490	2,600	72	26	33.62	0.0069

B.5.1.6. Lighting Hours of Use (HOU) Metering

Hours of use were estimated through direct monitoring of lighting in the on-site sample homes. Each logger was extrapolated to full annual usage by using a linear model with day length as the predictor, where day length varies inversely with the number of hours of use. Latitude and longitude coordinates for New Orleans, Louisiana were used in the computation of day length (29.9511, -90.0715). The regression used to extrapolate the meter data to a full year is shown in the equation below.

$$H_d = \alpha + \beta * \text{Day Length} + \varepsilon_d$$

Where:

H_d = hours of use on day d

Day Length = Number of daylight hours on day d

α and β are coefficients determined by the regression

ε_d = residual error.

A similar model was run which added room type as an explanatory variable in order to estimate hours of use for each room type.

B.5.1.6.1. Hours of Use Results

Results of the regressed logger data provided ADM with overall efficient lighting hours of use, as well as breakdowns of hours of use by room type as shown in. In total 176 lighting loggers were used, and all results were found to meet precision requirements. Overall daily HOU are 2.25, which corresponds to 819 annual HOU. The coefficients from the overall model and the model which adds room type are also shown below.

Table 84: Hours of Use by Area

Area/Room	*HOU Annual*	*HOU Daily*	*# Loggers*	*Precision*
Kitchen	761	2.08	39	0.06
Living Room	669	1.83	39	0.06
Bedroom	775	2.12	28	0.08
Bath	1,143	3.13	34	0.05
Dining Room	790	2.17	36	0.06
Overall	819	2.25	176	0.03

Table 85: Lighting Model Coefficients

Coefficient	*Estimate*	*SE*	*T-Stat*	*P-value*
Intercept	2.526	0.694	3.640	0.000
Day Length	-0.023	0.053	-0.437	0.662

The graph below is a scatterplot showing average hours of use for all of the loggers in the M&V sample and the corresponding day length (based on New Orleans, LA). The fitted line shows a slightly negative relationship between average daily hours and day length, which an expedited pattern ex-ante. The day length coefficients for both models also confirm this relationship, as they are both negative, although neither is statistically significant.

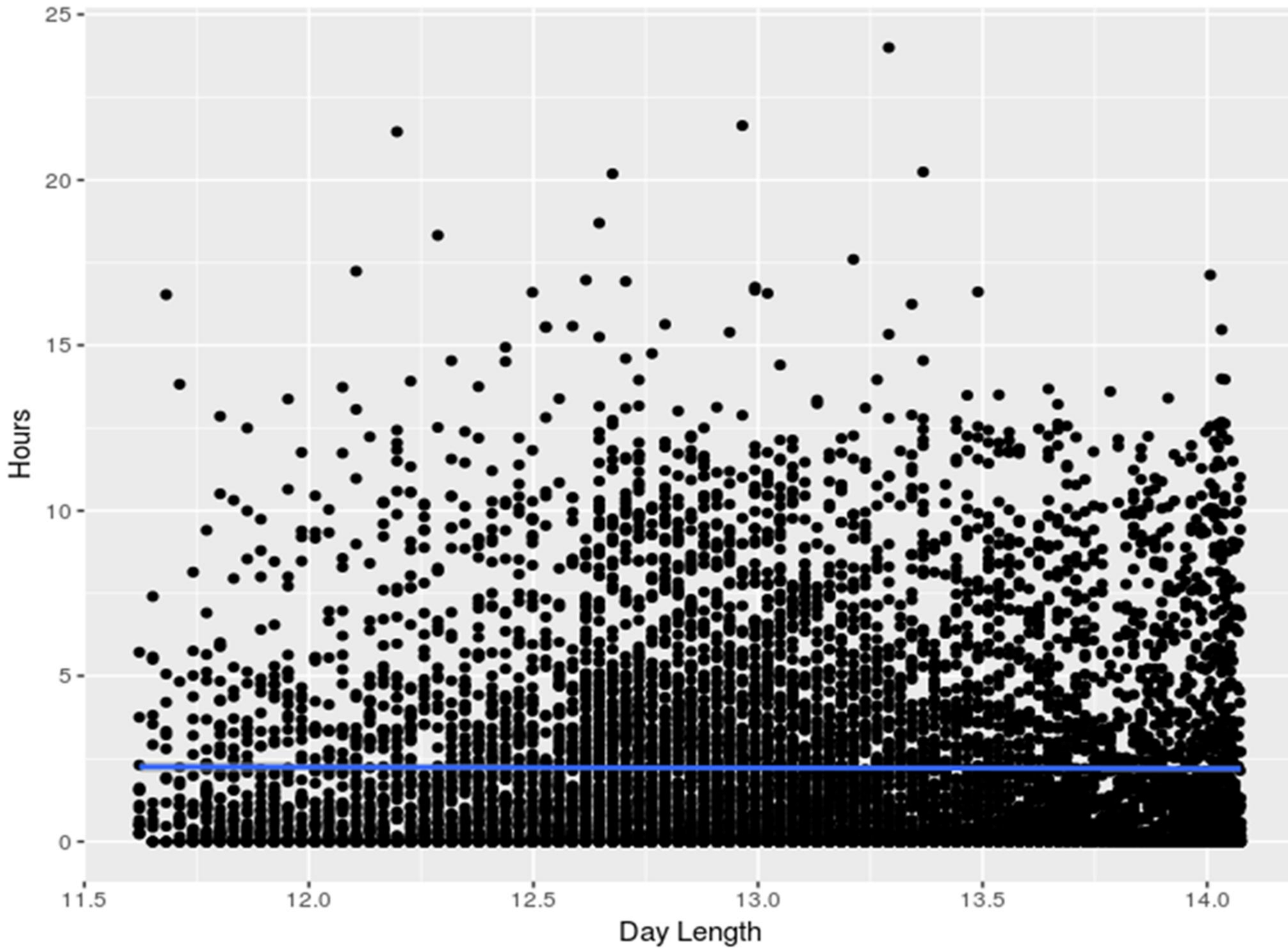

Table 86: Lighting Room Model Coefficients

Coefficient	Estimate	SE	T-Stat	P-value
Intercept	2.607	0.690	3.777	0.000
Day Length	-0.043	0.052	-0.818	0.413
Bedroom	-0.250	0.097	-2.572	0.010
Dining Room	0.038	0.104	0.362	0.718
Kitchen	1.048	0.099	10.600	0.000
Living Room	0.081	0.097	0.828	0.408

B.5.1.6.2. Coincidence Factor

ADM calculated the coincident factor (CF) based on actual lighting logger data in June between the hours of 3 and 6 pm as 12.74%.

B.5.1.7. Calculation of Deemed Savings

For retail (time of sale) programs, increased savings may be claimed based on sales to nonresidential customers.[162] Based on a review of 23 utility programs across 10 states, 6.7% of installed lamps may be allocated to the commercial program. To implement, multiply the total number of fixtures by 6.7% and apply the savings methodologies described in the Commercial Lighting Efficiency measure. Since no building type will have been identified, apply the weighted average annual operating hours and coincidence factor based on a review of the building types that participating in commercial lighting programs during the current program year.

Calculate savings for the remaining 93.3 percent of fixtures using the residential savings calculations described below. If it is not possible to apply the commercial allocation strategy described above, a program may calculate savings for all fixtures using the residential savings calculations described below. This will result in a conservative estimate for upstream programs. Note: This strategy should only be applied to retail (time of sale) programs. For all other programs, use the residential savings calculations exclusively.

B.5.1.7.1. Energy Savings

$$kWh_{savings} = \left((W_{base} - W_{post})/1000\right) \times Hours \times ISR \times IEF_E$$

Where:

W_{base} = Based on wattage equivalent of the lumen output of the purchased CFL lamp and the program year purchased/installed

W_{post} = Actual wattage of CFL purchased/installed

$Hours$ = Average hours of use per year

IEF_E = Interactive Effects Factor to account for cooling energy savings and heating energy penalties; this factor also applies to outdoor and unconditioned spaces

ISR = In Service Rate, or percentage of rebate units that get installed, to account for units purchased but not immediately installed

When the EISA 2007 standard goes into effect for a CFL, the reduced wattage savings should be claimed for the rest of the measure life. For example, up until 2022, a 20W CFL with 1200 lumens may claim a 53W baseline. After 2022, the baseline becomes 27W for the remainder of the measure life.

[162] Dimetrosky, S., Parkinson, K. & Lieb, N. 2015, “Residential Lighting Evaluation Protocol – The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.” January.

Table 87: ENERGY STAR® CFLs – EISA Baselines[163]

Minimum Lumens	Maximum Lumens	Incandescent Equivalent 1st Tier EISA 2007 (W_{base})	Incand. Equiv. 2nd Tier EISA 2007 (W_{base})[164]	Effective dates for 2nd Tier EISA 2007 Baselines
310	749	29	12	1/1/2023
750	1,049	43	20	1/1/2023
1,050	1,489	53	28	1/1/2023
1,490	2,600	72	45	1/1/2023

Table 88: ENERGY STAR® CFLs – Average Hours of Use Per Year

Installation Location	Hours
Blended Indoor/Outdoor[165]	819.43

Table 89: ENERGY STAR® CFLs – In Service Rates

Program	CFL ISR
Retail (Time of Sale) and Direct Install[166]	0.98

Table 90: ENERGY STAR® CFLs – IEF for Cooling/Heating Savings

Heating Type	Interactive Effects Factor (IEF_E)[167]
Gas Heat with AC	1.10

[163] Note that ENERGY STAR® has assigned new incandescent equivalent wattage lumen bins for the upcoming ENERGY STAR® lighting standards, coming into effect September 2014. Due to the likelihood of sell-through of existing ENERGY STAR® lighting through fall 2014 and the on-going use of the EISA bin definitions, this TRM maintains the EISA lumen bins for assigning baseline wattage. Future TRM iterations of the AR TRM, however, may incorporate these new lumen bins for baseline wattage estimates.

[164] Wattages developed using the 45 lpw standard that goes into effect in 2020.

[165] Indoor Hours based off aggregated lighting study performed by ADM looking at lighting logger data from 80 homes.

[166] Dimetrosky, S. et al, 205, ,"Residential Lighting Evaluation Protocol – The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures." January. ISR for upstream programs, including storage lamps installed within four years of purchase.

[167] Refer to Appendix I, Arkansas TRM 6.0 Volume 3.

Gas Heat with no AC	1.00
Electric Resistance Heat with AC	0.83
Electric Resistance Heat with no AC	0.73
Heat Pump	0.96
Heating/Cooling Unknown[168]	0.91

B.5.1.7.2. Peak Demand Savings

$$kW_{savings} = \left(\left(W_{base} - W_{post}\right)/1000\right) \times CF \times ISR \times IEF_D$$

Where:

CF = Coincidence Factor, 12.74%

IEF_D = Interactive Effects Factor to account for cooling demand savings; this factor also applies to outdoor and unconditioned spaces

Table 91: Residential Lighting Efficiency – Summer Peak Coincidence Factor

Lamp Location	***CF***
Indoor[169]	10%
Outdoor	0%

Table 92: ENERGY STAR® CFLs – IEF for Cooling Demand Savings

Heating Type	***Interactive Effects Factor (IEF_D)[170]***
Gas Heat with AC	1.29

[168] Unknown factors are based on EnergyStar Interactive effects, weighted by primary data collected on New Orleans typical HVAC arrangements.

[169] Residential light logging study by Cadmus - Entergy Arkansas, Inc. 2013 EM&V Evaluation Report.

[170] Refer to Appendix I, Arkansas TRM 6.0 Volume 3.

Gas Heat with no AC	1.00
Electric Resistance Heat with AC	1.29
Electric Resistance Heat with no AC	1.00
Heat Pump	1.29
Heating/Cooling Unknown[171]	1.21

B.5.1.7.3. Heating Penalty for Natural Gas Heated Homes

$$Therms_{penalty} = \left(\left(W_{base} - W_{post}\right)/1000\right) \times ISR \times IEF_G$$

Where:

IEF_G = Interactive Effects Factor to account for gas heating penalties (Δtherm/kWh); this factor also applies to outdoor and unconditioned spaces

Table 93: ENERGY STAR® CFLs – IEF for Gas Heating Penalties

Heating Type	***Interactive Effects Factor (IEF_G)[172]***
Gas Heat with AC	-0.011
Gas Heat with no AC	-0.011
Electric Resistance Heat with AC	0
Electric Resistance Heat with no AC	0
Heat Pump	0
Heating/Cooling Unknown[173]	-0.0063

B.5.1.8. Annual kW, Annual kWh, and Lifetime kWh Savings Calculation Example

A 5W CFL is installed in program year (PY) 2016. In July 2014 Tier 1 EISA 2007 standards went into effect, and the baseline shifted to 29 watts. In January 2023, due to Tier 2 EISA 2007 standards going into effect, the baseline will shift again to 12 watts. This CFL has a rated life of 15,000 hours. Necessary inputs for calculating the kWh savings include the EUL (13.0 years), IEF_D (1.25 for unknown heating/cooling type), IEF_E (0.97 for unknown cooling/heating type), ISR (0.98), summer coincidence factor

[171] Unknown factors are based on EnergyStar Interactive effects, weighted by primary data collected on New Orleans typical HVAC arrangements.

[172] Refer to Appendix I, Arkansas TRM 4.0 Volume 3

[173] Weighted average based on Residential Energy Consumption Survey (RECS) 2009 data. http://www.eia.gov/consumption/residential/data/2009/.

(0.1), and Hours of Use per Year (819.43 hours). All kWh values are rounded to the second decimal place.

PY 2016 through PY 2022 Savings: From January 2016 to December 2022, the baseline is 29 watts. 2023 – 2016 is 7 years.

$$2017\ to\ 2023\ kW\ Savings\ (for\ each\ year) = \left(\frac{[29-5]}{1000}\right) \times 0.1 \times 1.25 \times 0.98$$

$$= 0.0029\ kW$$

$$Cumulative\ 2017\ to\ 2023\ kWh\ Savings = \left(\frac{[29-5]}{1000}\right) \times 819.43 \times 0.97 \times 0.98 \times 6$$

$$= 112.17\ kWh$$

PY 2023 through PY 2028 Savings: In January 2023, the baseline changes to the 2nd Tier EISA 2007 standard. The baseline wattage changes from 29 watts to 12 watts. The remaining measure life is 7 years.

$$2023\ to\ 2028\ kW\ Savings\ (for\ each\ year) = \left(\frac{[12-5]}{1000}\right) \times 0.1 \times 1.25 \times 0.98$$

$$= 0.0009\ kW$$

$$Cumulative\ 2023\ to\ 2028\ kWh\ Savings = \left(\frac{[12-5]}{1000}\right) \times 819.43 \times 0.97 \times 0.98 \times 7$$

$$= 38.17\ kWh$$

Lifetime kWh Savings:

$$112.17 + 38.17 = 15034\ kWh\ lifetime\ savings$$

B.5.1.9. Incremental Cost

Costs by delivery channel area as follows:

- Retail Markdown: $1.20[174]
- Direct Install: program actual. If unavailable, use full measure cost of $2.45 per bulb plus $5 installation cost[175].
- Efficiency Kits: program actual.

B.5.1.1. Future Studies

This measure is a High Impact Measure, having constituted more than 1% of residential Energy Smart program savings. However, most the major research need (hours of use

[174] Cites Illinois TRM.

[175] Assumes 15 minutes at $20/hour. This includes proration of travel time to the site.

and coincidence) has been completed. We recommend conducting metering of residential exterior lighting in PY7. However, given the pending code change to EISA Phase II starting in 2020, this measure should not be the focus of other research studies for future program implementation. EM&V for this measure should focus on savings validation.

ADM recommends that this measure cease implementation when EISA Phase II takes effect in 2020, unless program administrators can show that the savings are still cost-effective under the more stringent baseline.

B.5.2. ENERGY STAR® Specialty Compact Fluorescent Lamps (CFLs)

B.5.2.1. Measure Description

This measure provides a method for calculating savings for replacing a specialty incandescent or halogen lamp with an ENERGY STAR®-qualified specialty CFL. These lamps include R, PAR, ER, BR, BPAR, globes G40, decorative globes equal to or less that 60W with candelabra base, and decorative candles equal to or less than 60W with candelabra base.

B.5.2.2. Baseline Wattage

The baseline wattages for specialty lamps are presented in Table 94 and Table 95.

Table 94: ENERGY STAR® Specialty CFLs - Baseline Watts for Reflector Lamps[176]

[176]Based on manufacturer available reflector lighting products as available in August 2013.

Lamp Type (a)	Incandescent Equivalent (Pre-EISA) (b)	$Watts_{Base}$ (Post-EISA) (c)
PAR20	50	35
PAR30	50	35
R20	50	45
PAR38	60	55
BR30	65	EXEMPT
BR40	65	EXEMPT
ER40	65	EXEMPT
BR40	75	65
BR30	75	65
PAR30	75	55
PAR38	75	55
R30	75	65
R40	75	65
PAR38	90	70
PAR38	120	70
R20	≤ 45	EXEMPT
BR30	≤ 50	EXEMPT
BR40	≤ 50	EXEMPT
ER30	≤ 50	EXEMPT
ER40	≤ 50	EXEMPT

For other specialty, EISA exempt lamps[177], use the baseline wattage in Table 95. Commonly used EISA exempt lamps include 3-way lamps, globes with ≥ 5” diameter or ≤ 749 lumens, and candelabra base lamps with ≤ 1049 lumens. See EISA legislation for full list of exemptions. If rated lumen values fall above or below these values, use manufacturer rated equivalent incandescent wattage.

[177] A complete list of the 22 incandescent lamps exempt from EISA 2007 is listed in the United States U.S. DOE Impact of EISA 2007 on General Service Incandescent Lamps: FACT SHEET. www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/general_service_incandescent_factsheet.pdf.

Table 95: Baseline Wattage for Specialty, EISA Exempt Lamps[178]

Minimum Lumens	***Maximum Lumens***	***Incandescent Equivalent (Wbase)***
310	749	40
750	1,049	60
1,050	1,489	75
1,490	2,600	100

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B.5.2.3. Efficiency Standard

CFLs must be an ENERGY STAR® specialty CFL.

Exceptions to the ENERGY STAR® label are allowed for unlisted lamps, fixtures or other lighting-related devices that have been submitted to ENERGY STAR® for approval. If the lamp or fixture does not achieve ENERGY STAR® approval within the program year, however, then the lamp or fixture would have to be immediately withdrawn from the program.

B.5.2.4. Estimated Useful Life (EUL)

The average measure life is based upon rated lamp life of the CFL shown in the following table. The measure life assumes an average daily use of 2.24 blended hours for indoor/outdoor applications and applies a 0.688[179] degradation factor to indoor residential CFLs.

Table 96: ENERGY STAR® Specialty CFLs – Measure Life[180]

Rated Measure Life (Hours)	***Measure Life (Years)***

[178] Note that ENERGY STAR® has assigned new incandescent equivalent wattage lumen bins for the upcoming ENERGY STAR® lighting standards, coming into effect September 2014. Due to the likelihood of sell-through of existing ENERGY STAR® lighting through fall 2014 and the on-going use of the EISA bin definitions, this TRM maintains the EISA lumen bins for assigning baseline wattage. Future TRM iterations of the AR TRM, however, may incorporate these new lumen bins for baseline wattage estimates.

[179] Average of 0.526 and 0.85. Original 0.526 is from Itron, Hirsch and Associates, and Research Into Action, "Welcome to the Dark Side: The Effect of Switching on CFL Measure Life". 2008 ACEEE Summer Study on Energy Efficiency in Buildings, p. 2-146; and 0.85 is from ENERGY STAR® CFL THIRD PARTY TESTING AND VERIFICATION Off-the-Shelf CFL Performance: Batch 3. Figure 27, p. 47.

[180] EUL = Rated Measure Life in Hours * Degradation Factor / (365.25 * Average Hours of Daily Use). Degradation Factor = 0.526 for indoor applications and 1.000 for outdoor applications.

8,000	7
10,000	9
12,000	10
15,000	13

B.5.2.1. Deemed Savings Per Lamp

Table 97 summarizes the unit energy savings for specialty CFLs in each lumen bin. This assumes retail markdown delivery and an unknown heating and cooling system configuration.

Table 97: ENERGY STAR® Specialty CFLs – Deemed Savings Per Lamp

Minimum Lumens	***Maximum Lumens***	***Incandescent Equivalent 1st Tier EISA 2007 (W_{base})***	***CFL Wattage***	***kWh/Lamp***	***kW/Lamp***
310	749	40	10	21.92	0.0045
750	1,049	60	14	33.62	0.0069
1,050	1,489	75	20	40.19	0.0083
1,490	2,600	100	26	54.08	0.0112

B.5.2.2. Coincidence Factor

Coincidence factors align with those specified for standard configuration CFLs, 12.75%, based on ADM metering.

B.5.2.3. Calculation of Deemed Savings

Deemed savings are calculated in the same manner as for standard CFLs (see Section B.5.2.3).

B.5.2.4. Incremental Cost

Costs by delivery channel area as follows:

- Retail Markdown: $5.00[181]
- Direct Install: program actual. If unavailable, use full measure cost of $8.50 per bulb plus $5 installation cost[182]
- Efficiency Kits: program actual

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[181] NEEP Residential Lighting Survey, 2011 .

[182] Assumes 15 minutes at $20/hour. This includes proration of travel time to the site.

B.5.2.5. Future Studies

This measure is a High Impact Measure, having constituted more than 1% of residential Energy Smart program savings. However, the major research need (hours of use and coincidence) has been completed. Further, given the pending code change to EISA Phase II starting in 2020, this measure should not be the focus of research studies for future program implementation. EM&V for this measure should focus on savings validation.

ADM recommends that this measure cease implementation when EISA Phase II takes effect in 2020, unless program administrators can show that the savings are still cost-effective under the more stringent baseline.

B.5.3. ENERGY STAR® Directional LEDs

B.5.3.1. Measure Description

This measure provides a method for calculating savings for replacing an incandescent or halogen reflector or decorative lamp with an ENERGY STAR® qualified LED lamp. These lamp shapes include PAR, R, BR, MR, and similar lamp shapes.

B.5.3.2. Baseline

Directional lamps are not covered under EISA legislation. Instead, directional lamps are governed by a 2009 DOE rulemaking for Incandescent Reflector Lamps (IRL)—this ruling went into effect in July 2012. The baselines for these products are from this IRL ruling in July 2012.

Table 98: ENERGY STAR® Directional LEDs – Reflector Lamps Baseline Watts [183]

Lamp Type (a)	Incandescent Equivalent (Pre-EISA) (b)	$Watts_{Base}$ (Post-EISA) (c)
PAR20	50	35
PAR30	50	35
R20	50	45
PAR38	60	55
BR30	65	EXEMPT
BR40	65	EXEMPT
ER40	65	EXEMPT
BR40	75	65
BR30	75	65
PAR30	75	55
PAR38	75	55
R30	75	65
R40	75	65
PAR38	90	70
PAR38	120	70
R20	≤ 45	EXEMPT
BR30	≤ 50	EXEMPT
BR40	≤ 50	EXEMPT
ER30	≤ 50	EXEMPT
ER40	≤ 50	EXEMPT

For other specialty, EISA exempt lamps[184], use the baseline wattage in

[183] Based on manufacturer available reflector lighting products as available in August 2013.

[184] A complete list of the 22 incandescent lamps exempt from EISA 2007 is listed in the United States U.S. DOE Impact of EISA 2007 on General Service Incandescent Lamps: FACT SHEET. www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/general_service_incandescent_factsheet.pdf.

Table 102. Commonly used EISA exempt lamps include 3-way lamps, globes with ≥ 5" diameter or ≤ 749 lumens, and candelabra base lamps with ≤ 1049 lumens. See EISA legislation for full list of exemptions. If rated lumen values fall above or below these values, use manufacturer rated equivalent incandescent wattage.

Table 99: ENERGY STAR® Directional LEDs –Baseline Watts for EISA-Exempt Lamps185

Minimum Lumens	***Maximum Lumens***	***Incandescent Equivalent (W_{base})***
310	749	40
750	1,049	60
1,050	1,489	75
1,490	2,600	100

B.5.3.3. Efficiency Standard

LEDs must be ENERGY STAR® qualified for the relevant lamp shape being removed.

Exceptions to the ENERGY STAR® label are allowed for unlisted lamps, fixtures or other lighting-related devices that have been submitted to ENERGY STAR® for approval. If the lamp or fixture does not achieve ENERGY STAR® approval within the Arkansas DSM program year, however, then the lamp or fixture would have to be immediately withdrawn from the program.

B.5.3.4. Estimated Useful Life (EUL)

The measure life for indoor and outdoor LED reflector and decorative lamps is 20 years.[186]

B.5.3.1. Deemed Savings Per Lamp

[185] Note that ENERGY STAR® has assigned new incandescent equivalent wattage lumen bins for the upcoming ENERGY STAR® lighting standards, coming into effect September 2014. Due to the likelihood of sell-through of existing ENERGY STAR® lighting through fall 2014 and the on-going use of the EISA bin definitions, this TRM maintains the EISA lumen bins for assigning baseline wattage.

[186] Emerging Technologies Research Report prepared for the Regional Evaluation, Measurement, and Verification Forum facilitated by the Northeast Energy Efficiency Partnerships (NEEP). February 13, 2013.

Table 100 summarizes the unit energy savings for directional LEDs by lamp configuration. This assumes retail markdown delivery and an unknown heating and cooling system configuration.

Table 100: Deemed Savings for ENERGY STAR® Directional LEDs

Lamp Type	Incandescent Equivalent (Pre-EISA)	Baseline Watts	Efficient Watts	kWh/Lamp	kW/Lamp
PAR20	50	35	8	19.69	0.00408
PAR30	50	35	11	17.50	0.00363
R20	50	45	8	26.98	0.00559
PAR38	60	55	11	32.08	0.00665
BR30	65	65	10	40.10	0.00832
BR40	65	65	14	37.19	0.00771
ER40	65	65	14	37.19	0.00771
BR40	75	65	14	37.19	0.00771
BR30	75	65	13	37.92	0.00786
PAR30	75	55	13	30.62	0.00635
PAR38	75	55	14	29.89	0.00620
R30	75	65	9	40.83	0.00847
R40	75	65	12	38.64	0.00801
PAR38	90	70	11	43.02	0.00892
PAR38	120	70	15	40.10	0.00832
R20	≤ 45	45	6	28.44	0.00590
BR30	≤ 50	50	9	29.89	0.00620
BR40	≤ 50	50	12	27.71	0.00575
ER30	≤ 50	50	11	28.44	0.00590
ER40	≤ 50	50	12	27.71	0.00575

B.5.3.2. Daily Hours of Use

These deemed savings assume an average daily use of 2.24 blended hours for indoor/outdoor applications.

B.5.3.3. Coincidence Factor

Coincidence factors align with those specified for standard configuration CFLs, 12.75%, based on ADM metering.

B.5.3.4. Incremental Cost

Prices for LEDs decrease each year. Given this, actual lighting costs should be compared to a stipulated baseline cost where feasible. If that information is not available, use costs detailed in the table below

Table 101: ENERGY STAR® Directional LEDs Incremental Costs[187]

Lamp Type	Year	Incandescent Cost	LED Cost	Incremental Cost
Recessed Downlight Luminaires	2017-2019	$4.00	$94.00	$90.00
Track Lights	2017-2019	$4.00	$60.00	$56.00
Directional	2017	$3.53	$6.24	$2.71
	2018-2019		$5.18	$1.65
Decorative & Globe	2017	$1.60	$3.50	$1.90
	2018-2019	$1.74	$3.40	$1.66

B.5.3.5. Calculation of Deemed Savings

Deemed savings are calculated in the same manner as for standard CFLs (see Section B.5.2.3).

For other specialty, EISA exempt lamps[188], use the baseline wattage in

[187] Based on Illinois TRM.

[188] A complete list of the 22 incandescent lamps exempt from EISA 2007 is listed in the United States U.S. DOE Impact of EISA 2007 on General Service Incandescent Lamps: FACT SHEET. www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/general_service_incandescent_factsheet.pdf.

Table 102. Commonly used EISA exempt lamps include 3-way lamps, globes with ≥ 5" diameter or ≤ 749 lumens, and candelabra base lamps with ≤ 1049 lumens. See EISA legislation for full list of exemptions. If rated lumen values fall above or below these values, use manufacturer rated equivalent incandescent wattage.

Table 102: ENERGY STAR® Directional LEDs –Baseline Watts for EISA-Exempt Lamps[189]

Minimum Lumens	**Maximum Lumens**	**Incandescent Equivalent (W_{base})**
310	749	40
750	1,049	60
1,050	1,489	75
1,490	2,600	100

B.5.3.1. Future Studies

This measure is a High Impact Measure, having constituted more than 1% of residential Energy Smart program savings. However, the major research need (hours of use and coincidence) has been completed. Further, given the pending code change to EISA Phase II starting in 2020, this measure should not be the focus of research studies for future program implementation. EM&V for this measure should focus on savings validation.

ADM recommends that this measure cease implementation when EISA Phase II takes effect in 2020, unless program administrators can show that the savings are still cost-effective under the more stringent baseline.

[189] Note that ENERGY STAR® has assigned new incandescent equivalent wattage lumen bins for the upcoming ENERGY STAR® lighting standards, coming into effect September 2014. Due to the likelihood of sell-through of existing ENERGY STAR® lighting through fall 2014 and the on-going use of the EISA bin definitions, this TRM maintains the EISA lumen bins for assigning baseline wattage.

B.5.4. ENERGY STAR® Omni-Directional LEDs

B.5.4.1. Measure Description

This measure provides a method for calculating savings for replacing an incandescent lamp with an omni-directional LED in residential applications. The applicable lamp types that are omni-directional LEDs are the following shapes, using ANSI C79.1-2002 nomenclature: A, BT, P, PS, S, and T.[190]

B.5.4.2. Baseline

The baseline equipment is assumed to be an incandescent or halogen lamp with adjusted baseline wattages compliant with EISA 2007 regulations dictate higher efficiency baseline lamps.

The first Tier of EISA 2007 regulations were in from January 2012 to January 2014. Beginning January 2012, a typical 100W lamp wattage was reduced to comply with a maximum 72W lamp wattage standard for a rated lumen output range of 1,490-2,600 lumens. Beginning January 2013, a typical 75W lamp wattage was reduced to comply with a maximum 53W lamp wattage standard for a rated lumen output range of 1,050-1,489 lumens. Beginning January 2014, typical 60W and 40W lamp wattages were reduced to comply with maximum 43W and 29W lamp wattage standards for rated lumen output ranges of 750-1,049 and 310-749 lumens.

The second Tier of EISA 2007 regulations go into effect beginning January 2020. At that time, general service lamps must comply with a 45 lumen per watt efficacy standard. Since the EUL of some lamps in this measure extend beyond that date, the baseline should be adjusted to the second Tier for any years after 2022. [191]

The baselines are summarized in Table 103.

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[190] According to ENERGY STAR®, omni-directional LED products "…shall have an even distribution of luminous intensity (candelas) within the 0° to 135° zone (vertically axially symmetrical). Luminous intensity at any angle within this zone shall not differ from the mean luminous intensity for the entire 0° to 135° zone by more than 20%. At least 5% of total flux (lumens) must be emitted in the 135°-180° zone. Distribution shall be vertically symmetrical as measured in three vertical planes at 0°, 45°, and 90°." http://www.energystar.gov/ia/partners/product_specs/program_reqs/Integral_LED_Lamps_Program_Requirements.pdf.

[191] First tier EISA compliant halogens have a lifetime of 4 years (3,000 hours at 2.17 hours per day). The last year these lamps are available is 2019, and they will need replacement at the end of 2022. Thus, the new standard must be used after 2022.

Table 103: ENERGY STAR® Omni-Directional LEDs – EISA Baselines

Minimum Lumens	Maximum Lumens	Incandescent Equivalent 1st Tier EISA 2007 (W_{base})	Incandescent Equivalent 2nd Tier EISA 2007 (W_{base})[192]	Effective dates for 2nd Tier EISA 2007 Baselines
310	749	29	12	1/1/2023
750	1,049	43	20	1/1/2023
1,050	1,489	53	28	1/1/2023
1,490	2,600	72	45	1/1/2023

B.5.4.3. Efficiency Standard

Omni-directional LEDs must be a standard ENERGY STAR® qualified omni-directional LED.

Exceptions to the ENERGY STAR® label are allowed for unlisted lamps, fixtures or other lighting-related devices that have been submitted to ENERGY STAR® for approval. If the lamp or fixture does not achieve ENERGY STAR® approval within the Arkansas DSM program year, however, then the lamp or fixture would have to be immediately withdrawn from the program.

B.5.4.4. Estimated Useful Life (EUL)

The measure life for indoor and outdoor LED omni-directional lamps is 20 years[193]. Due to the EISA standards, the savings over the useful life will need to be adjusted to account for second tier EISA standards for all years after 2022.

Table 104: ENERGY STAR® Omni-Directional LEDs – Measure Life

Rated Measure Life (Hours)	First Tier EISA Standard Baseline	Second Tier EISA Standard Baseline
$\geq$ 25,000[194]	6	14

B.5.4.5. Deemed Savings Per Lamp

Table 105 summarizes the unit energy savings for directional LEDs in each lumen bin. This assumes retail markdown delivery and an unknown heating and cooling system configuration.

[192] Wattages developed using the 45 lpw standard that goes into effect in 2020.

[193] Emerging Technologies Research Report prepared for the Regional Evaluation, Measurement, and Verification Forum facilitated by the Northeast Energy Efficiency Partnerships (NEEP). February 13, 2013.

[194] Minimum requirement from current ENERGY STARÒ specification. https://www.energystar.gov/products/lighting_fans/light_bulbs/key_product_criteria.

Table 105: ENERGY STAR® Omnidirectional LEDs – Deemed Savings Per Lamp

Minimum Lumens	Maximum Lumens	Incandescent Equivalent 1st Tier EISA 2007 (W_{base})	LED Wattage	kWh/Lamp	kW/Lamp
310	749	29	7	16.04	0.00333
750	1,049	43	9	24.79	0.00514
1,050	1,489	53	12	29.89	0.00620
1,490	2,600	72	15	41.56	0.00862

B.5.4.6. Daily Hours of Use

These deemed savings assume an average daily use of 2.24 blended hours for indoor/outdoor applications.

B.5.4.7. Coincidence Factor

Coincidence factors align with those specified for standard configuration CFLs, 12.75%, based on ADM metering.

B.5.4.8. Calculation of Savings

Deemed savings are calculated in the same manner as for standard CFLs (see Section B.5.2.3.

B.5.4.9. Incremental Cost

Prices for LEDs decrease each year. Given this, actual lighting costs should be compared to a stipulated baseline cost where feasible. If that information is not available, use costs detailed in the table below.

Table 106: ENERGY STAR® Directional LEDs Incremental Costs[195]

Year	EISA-Compliant Halogen	LED A-Lamp	Incremental Cost
2017	$1.25	$3.21	$1.96
2018	$1.25	$3.21	$1.96
2019	$1.25	$3.11	$1.86

B.5.4.10. Future Studies

This measure is a High Impact Measure, having constituted more than 1% of residential Energy Smart program savings. However, the major research need (hours of use and coincidence) has been completed. Further, given the pending code change to EISA

[195] Based on Illinois TRM.

Phase II starting in 2020, this measure should not be the focus of research studies for future program implementation. EM&V for this measure should focus on savings validation.

ADM recommends that this measure cease implementation when EISA Phase II takes effect in 2020, unless program administrators can show that the savings are still cost-effective under the more stringent baseline.

C.Commercial Measures

C.1. Commercial Motors

C.1.1. Electronically Commutated Motors for Refrigeration and HVAC Applications

C.1.1.1. Measure Description

An electronically commutated motor (ECM) is a fractional horsepower direct current (DC) motor used most often in commercial refrigeration applications such as display cases, walk-in coolers/freezers, refrigerated vending machines, and bottle coolers. ECMs can also be used in HVAC applications, primarily as small fan motors for packaged terminal units or in terminal air boxes. ECMs generally replace shaded pole (SP) or permanent split-capacitor (PSC) motors and offer energy savings of at least 50 percent.

C.1.1.2. Baseline and Efficiency Standards

The standard motor type for this application is a shaded pole or permanent split-capacitor motor.

Any ECM up to 1 HP in size will meet the minimum requirements for both retrofit and new construction installations.

C.1.1.3. Estimated Useful Life (EUL)

In accordance with DEER 2014, the estimated useful life (EUL) is 15 years.

C.1.1.4. Deemed Savings Values

Table 107 summarizes deemed kWh and kW by facility type for this measure. The following assumptions are used:

- Baseline watts: 102. This is the average of SP motors (132W) and PSC motors (72W).
- Hours:
    - HVAC: 4,386
    - Refrigeration: 8,760
    - Unknown: 6,573
- COP:
    - HVAC: 3.45 (assumes 11.8 EER)
    - Refrigeration: 1.90 (average of refrigerator and freezer)
    - Unknown: 2.67

- Duty Cycle:
  - HVAC: 1.00
  - Refrigeration: .97 (average of refrigerator and freezer)
  - Unknown: .985

Table 107: Deemed Savings by Facility Type

End-Use	HVAC		Refrigeration		Unknown	
Building Type	kWh	kW	kWh	kW	kWh	kW
Assembly	351	0.0656	829	0.0776	560	0.0699
College	351	0.0656	829	0.0753	552	0.0688
Fast Food	351	0.0672	829	0.0771	552	0.0705
Full Menu	351	0.0624	829	0.0716	552	0.0655
Grocery	351	0.0680	829	0.0780	552	0.0714
Health Clinic	351	0.0720	829	0.0826	552	0.0755
Large Office	351	0.0680	829	0.0780	552	0.0714
Lodging	351	0.0672	829	0.0771	552	0.0705
Religious Worship	351	0.0616	829	0.0707	552	0.0646
Retail	351	0.0656	829	0.0753	552	0.0688
Unknown	351	0.0704	829	0.0808	552	0.0739

C.1.1.5. Calculation of Deemed Savings

C.1.1.5.1. Energy Savings

$$kWh_{savings} = (kW_{base} - kW_{ECM}) \times Hrs \times DC \times (1 + \frac{1}{COP}) / 1000 \, {}^{W}/_{kW}$$

Where:

kW_{base} = Power of the motor being replaced; use known wattage of motor, or if unknown, use 132W (SP motors)[196] or 72W (PSC motors)[197]

kW_{ECM} = Power of the replacement EC motor; use known wattage of motor, or if unknown, use 40W[198]

[196] http://www.fishnick.com/publications/appliancereports/refrigeration/GE_ECM_revised.pdf

[197] The Massachusetts TRM specifies a load factor of 54% for SP motors and a load factor of 29% for PSC motors, as specified by National Resource Management (NRM). Multiplying the 132 W default value for SP motors by the ratio of PSC load factor to SP load factor results in a default PSC motor wattage of 72 watts.

The motor's power for either Base or ECM can be calculated using the following equation if power is not known. The values for rated wattage and phase can be found on motor's nameplate:

$$kW_{motor} = \frac{Volts \times Amperage}{1000} \times \sqrt{Phase} \times Power\ Factor$$

Hrs = Hours of yearly operation, use 8,760 hours for refrigeration and 4,386 for HVAC

DC = Duty cycle, only use a value of 0.94 if the application of the motor being replaced is for a freezer system. This is because the freezer will complete four 20-min defrost cycles per day where the evaporator fan will not be used. Use a value of 1 if the application is for a cooler refrigeration or HVAC.

$PowerFactor$ = Power factor of the motor, if not known an average value of 0.55 can be used for ECM in refrigeration, 0.7 for ECM in HVAC, and 0.85 for base motor in both applications.[199]

COP = Coefficient of Performance for the motors operation based on application. COP value depends on the end temperature of the refrigeration process. The COP values to use for refrigeration analysis are 1.3 for freezers and 2.5 for coolers[200]. For HVAC, use the EER value from install spec sheet and the conversion COP = EER/3.412.

C.1.1.5.2. Demand Savings

$$kW_{HVAC\ reduction} = (kW_{base} - kW_{ECM}) \times CF \times (1 + \frac{1}{COP})$$

$$kW_{Refrigeration\ reduction} = (kW_{base} - kW_{ECM}) \times DC \times CF \times (1 + \frac{1}{COP})$$

Where:

CF = Coincidence Factor, use values from Table 108 for HVAC applications; default value of 1.0 for refrigeration applications[201]

DC = Duty cycle, only use a value of 0.94 if the application of the motor being replaced is for a freezer refrigeration. This is because the freezer will complete four 20-min

[198] http://www.fishnick.com/publications/appliancereports/refrigeration/GE_ECM_revised.pdf

[199] http://www.ecw.org/sites/default/files/230-1.pdf

[200] PSC of Wisconsin, Focus on Energy Evaluation, Business Programs: Deemed Savings Manual V1.0, pp. 4-103 -4-106.

[201] CF set to 1.0 for refrigeration applications based on annual run-time assumption of 8,760 hours

defrost cycles per day where the evaporator fan will not be used. Use a value of 1 if the application is for a cooler refrigeration of HVAC.

Table 108: Commercial Coincidence Factors by Building Type[202]

Building Type	Coincidence Factor
Assembly	0.82
College	0.84
Fast Food	0.78
Full Menu	0.85
Grocery	0.90
Health Clinic	0.85
Large Office	0.84
Lodging	0.77
Religious Worship	0.82
Retail	0.88
School	0.71
Small Office	0.84

C.1.1.6. Incremental Cost

Incremental cost by end-use type is $177.[203]

C.1.1.7. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using ENERGY STAR default values. If this measure is added to Energy Smart programs, the evaluation should include a review of actual efficiency levels and costs of units purchased by New Orleans business and updates for applicable codes.

[202] Values for Assembly and Religious Worship building types developed using an adjustment factor derived through a comparison of average CFs for College/University and Assembly/Religious Worship building types from the Texas state Technical Reference Manual. College/University was selected as a reference building type due to average alignment with Assembly/Religious worship building types in other TRMs, inclusion of a summer session, and increased evening usage.

[203] Difference in the fully installed cost ($468) for ECM motor and controller, listed in Work Paper PGE3PREF126, "ECM for Walk-In Evaporator with Fan Controller," June 20,2012, and the measure cost specified in 4.6.6 ($291)

C.1.2. Premium Efficiency Motors

C.1.2.1. Measure Description

Currently a wide variety of NEMA premium efficiency motors from 1 to 500 HP are available. Deemed saving values for demand and energy savings associated with this measure must be for motors with an equivalent operating period (hours x Load Factor) over 1,000 hours.

C.1.2.2. Baseline and Efficiency Standards

C.1.2.2.1. Replace on Burnout

The EISA 2007 Sec 313 adopted the new federal standard and required that electric motors that are manufactured and sold in the United States meet the new standard by December 19, 2010. The standards can also be found in sections 431.25(c)-(f) of the Code of Federal Regulations (10 CFR Part 431).

With these changes, any 1-500 HP motor bearing the “NEMA Premium" trademark will align with national energy efficiency standards and legislation. The Federal Energy Management Program (FEMP) has already adopted NEMA MG 1-2006 Revision 1 2007 in its Designated Product List for federal customers.

In addition to the new standards for 200-500 HP motors, additional motors in the 1-200 HP range are now included in the NEMA Premium standard. These new motors are referred to as “General Purpose Electric Motors (Subtype II)”. These additional types of motors include:

- U-Frame Motors
- Design C Motors
- Close-coupled pump motors
- Footless motors
- Vertical solid shaft normal thrust (tested in a horizontal configuration)
- 8-pole motors
- All poly-phase motors with voltages up to 600 volts other than 230/460 volts (230/460 volt motors are covered by EPAct-92)

C.1.2.2.2. Early Retirement

The baseline for early retirement projects is the nameplate efficiency of the existing motor to be replaced, if known. If the nameplate is illegible and the in-situ efficiency cannot be determined, then the baseline should be based on the minimum efficiency allowed under the Federal Energy Policy Act of 1992 (EPAct), as listed in Table 110.

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NEMA Premium Efficiency motor levels continue to be industry standard for minimum-efficiency levels. The savings calculations assume that the minimum motor efficiency for both replace on burnout and early retirement projects exceeds that listed in Table 109.

For early retirement, the maximum age of an eligible piece of equipment is capped at the point at which it is expected that 75 percent of the equipment has failed. Where the age of the unit exceeds the 75 percent failure age, ROB savings should be applied. This cap prevents early retirement savings from being applied to projects where the age of the equipment greatly exceeds the estimated useful life of the measure.

Table 109. Premium Efficiency Motors – Replace on Burnout Baseline[204]

hp	$n_{baseline,\ Open\ Motors}$			$n_{baseline,\ Closed\ Motors}$		
	6-Pole	**4-Pole**	**2-Pole**	**6-Pole**	**4-Pole**	**2-Pole**
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	87.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	94.1
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4
250	94.5	95.4	94.5	95.0	95.0	95.4
300	94.5	95.4	95.0	95.0	95.4	95.4
350	94.5	95.4	95.0	95.0	95.4	95.4
400	n/a	95.4	95.4	n/a	95.4	95.4
450	n/a	95.8	95.8	n/a	95.4	95.4
500	n/a	95.8	95.8	n/a	95.8	95.4

[204] Federal Standards for Electric Motors, Table 1: Full Load Efficiencies for Standard Electric Motors, http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/50. Accessed June 2013.

Table 110 : Premium Efficiency Motors – Early Retirement Baseline[205]

hp	$n_{baseline, Open Motors}$			$n_{baseline, Closed Motors}$		
	6-Pole	4-Pole	2-Pole	6-Pole	4-Pole	2-Pole
1	80.0	82.5	75.5	80.0	82.5	75.5
1.5	84.0	84.0	82.5	85.5	84.0	82.5
2	85.5	84.0	84.0	86.5	84.0	84.0
3	86.5	86.5	84.0	87.5	87.5	85.5
5	87.5	87.5	85.5	87.5	87.5	87.5
7.5	88.5	88.5	87.5	89.5	89.5	88.5
10	90.2	89.5	88.5	89.5	89.5	89.5
15	90.2	91.0	89.5	90.2	91.0	90.2
20	91.0	91.0	90.2	90.2	91.0	90.2
25	91.7	91.7	91.0	91.7	92.4	91.0
30	92.4	92.4	91.0	91.7	92.4	91.0
40	93.0	93.0	91.7	93.0	93.0	91.7
50	93.0	93.0	92.4	93.0	93.0	92.4
60	93.6	93.6	93.0	93.6	93.6	93.0
75	93.6	94.1	93.0	93.6	94.1	93.0
100	94.1	94.1	93.0	94.1	94.5	93.6
125	94.1	94.5	93.6	94.1	94.5	94.5
150	94.5	95.0	93.6	95.0	95.0	94.5
200	94.5	95.0	94.5	95.0	95.0	95.0
250	94.5	95.4	94.5	95.0	95.0	95.4
300	94.5	95.4	95.0	95.0	95.4	95.4
350	94.5	95.4	95.0	95.0	95.4	95.4
400	n/a	95.4	95.4	n/a	95.4	95.4
450	n/a	95.8	95.8	n/a	95.4	95.4
500	n/a	95.8	95.8	n/a	95.8	95.4

C.1.2.3. Estimated Useful Life (EUL)

According to DEER 2014, the estimated useful life (EUL) is 15 years.

[205] Federal Standards for Electric Motor Efficiency from the Federal Energy Policy Act of 1992 (EPACT). http://www1.eere.energy.gov/manufacturing/tech_assistance/pdfs/e-pact92.pdf . Accessed June 2013.

C.1.2.4. Calculation of Deemed Savings

Actual motor operating hours are expected to be used to calculate savings. Every effort should be made to capture the estimated operating hours. Short and/or long term metering can be used to verify estimates. If metering is not possible, interviews with facility operators and review of operations logs should be conducted to obtain an estimate of actual operating hours. If there is not sufficient information to accurately estimate operating hours, then the annual operating hours in Table 111 or Table 115.

Table 111. Premium Efficiency Motors – Operating Hours, Load Factor (HVAC)

Building Type	Load Factor[206]	HVAC Fan Hours[207]
College/ University	0.75	4,581
Fast Food Restaurant		6,702
Full Menu Restaurant		5,246
Grocery Store		6,389
Health Clinic		7,243
Lodging		4,067
Large Office (>30k SqFt)		4,414
Small Office (≤30k SqFt)		3,998
Retail		5,538
School		4,165

Table 112: Premium Efficiency Motors – Operating Hours, Load Factor (Non-HVAC)

[206] Itron 2004-2005 DEER Update Study, Dec 2005; Table 3-25. Accessed May 2013.http://www.deeresources.com/deer2005/downloads/DEER2005UpdateFinalReport_ItronVersion.pdf .

[207] Fan schedule operating hours taken as the average of operating hours from the Connecticut, Maine, and Pennsylvania Technical Reference Manuals: CL&P and UI Program Savings Documentation for 2008 Program Year, Connecticut Lighting & Power Company; Efficiency Maine Technical Reference User Manual No. 2007-1; Pennsylvania Utility Commission Technical Reference Manual June 2012.

Industrial Processing	Load Factor[208]	Hours[209]					
		Chem	Paper	Metals	Petroleum Refinery	Food Production	Other
1-5 hp	0.54	4,082	3,997	4,377	1,582	3,829	2,283
6-20 hp	0.51	4,910	4,634	4,140	1,944	3,949	3,043
21-50 hp	0.60	4,873	5,481	4,854	3,025	4,927	3,530
51-100 hp	0.54	5,853	6,741	6,698	3,763	5,524	4,732
101-200 hp	0.75	5,868	6,669	7,362	4,170	5,055	4,174
201-500 hp	0.58	5,474	6,975	7,114	5,311	3,711	5,396
501-1,000 hp		7,495	7,255	7,750	5,934	5,260	8,157
>1,000 hp		7,693	8,294	7,198	6,859	6,240	2,601

C.1.2.4.1. Measure/Technology Review

Premium efficiency motors are a mature technology and a wealth of information exists on the measure. A summary of the key resources is included in Table 113.

Table 113: Premium Efficiency Motors- Review of Motor Measure Information

Resource	Notes

[208] United States Industrial Electric Motor Systems Market Opportunities Assessment, Dec 2002; Table 1-19. Accessed May 2013. www1.eere.energy.gov/manufacturing/tech_assistance/pdfs/mtrmkt.pdf

[209] United States Industrial Electric Motor Systems Market Opportunities Assessment, Dec 2002; Table 1-15. Accessed May 2013. www1.eere.energy.gov/manufacturing/tech_assistance/pdfs/mtrmkt.pdf

PG&E 2006[210]	Savings for common motor retrofits
Xcel Energy 2006[211]	Program level savings estimates for high-efficiency motors
DEER 2014[212]	Savings and cost for common motor retrofit
KEMA 2010[213]	Motor savings included in comprehensive potential study
CEE[214]	Industrial motor efficiency initiative
RTF[215]	Savings for common motor retrofit
ITP[216]	Savings for common motor retrofit
NPCC 2010[217]	Market information and overview of savings potential
NEMA 2009[218]	Minimum efficiency level for premium efficiency motors
MotorMaster+[219]	Comprehensive resource of motor efficiencies and tools to calculate savings
PacifiCorp 2009[220]	Motor savings included in comprehensive potential study

Deemed electric motor demand and energy savings should be calculated by the following formulas:

[210] Pacific Gas & Electric (PG&E). 2006. *2006 Motors Unit Savings Workpapers.V14.*

[211] Xcel Energy. 2006. 2007/2008/2009 *Triennial Plan Minnesota Natural Gas and Electric Conversation Improvement Program.*

[212] Consortium of Energy Efficiency. Commercial Lighting Program. http://library.cee1.org/content/commercial-lighting-qualifying-products-lists

[213] KEMA. 2010. *Measurement Manual*. Prepared for Tennessee Valley Authority.

[214] Consortium for Energy Efficiency. 2010. Industrial Motors & Motor Systems. http://library.cee1.org/content/cee-2012-summary-member-programs-motors-motor-systems

[215] Regional Technical Forum (RTF). http://rtf.nwcouncil.org/measures/

[216] Industrial Technologies Program http://www1.eere.energy.gov/industry/

[217] Northwest Power and Conservation Council (NPCC). 2010. *The Sixth Northwest Electric Power and Conservation Plan.*

[218] National Electrical Manufacturers Association (NEMA). 2009. *Motors and Generators. NEMA* MG 1-2009.

[219] MotorMaster+. 2010. https://www1.eere.energy.gov/manufacturing/tech_assistance/software_motormaster.html

[220] PacifCorp. 2009. *FinAnswer Express Market Characterization and Program Enhancements Utah Service Territory.*

C.1.2.4.2. Replace on Burnout (ROB)

$$kWh_{savings} = Rated\ Horsepower \times Conversion\ Factor \times LF \times \left(\frac{1}{\eta_{baseline}} - \frac{1}{\eta_{post}}\right) \times hours$$

$$kW_{reduction} = Rated\ Horsepower \times Conversion\ Factor \times LF \times \left(\frac{1}{\eta_{baseline}} - \frac{1}{\eta_{post}}\right) \times CF$$

Where:

$Rated\ HorsePower$ = Nameplate horsepower data of the motor

$Conversion\ Factor$ = 0.746 kW/hp

LF = Estimated load factor for the motor; if load factor is not available, deemed load factors in Table 111 or Table 115 can be used.

$\eta_{baseline}$= Efficiencies listed in Table 109 should be used (in the case of rewound motors, in situ efficiency may be reduced by a percentage as found in

)

η_{post}= Efficiency of the newly installed motor

Hours= Estimated annual operating hours for the motor; if unavailable, annual operating hours in Table 111 or Table 115 be used.

CF = Coincidence Factor = 0.74[221]

C.1.2.4.3. Early Retirement (ER)

Annual kWh and kW savings must be calculated separately for two time periods:

1. The estimated remaining life (RUL, see Table 114) of the equipment that is being removed, designated the first N years, and
2. Years EUL - N through EUL, where EUL is 15 years.

Table 114: Premium Efficiency Motors – Remaining Useful Life (RUL) of Replaced Systems[222,223]

[221] Itron 2004-2005 DEER Update Study, Dec 2005; Table 3-25. http://www.deeresources.com/deer2005/downloads/DEER2005UpdateFinalReport_ItronVersion.pdf Accessed May 2013.

Age of Replaced System (Years)	RUL (Years)
5	10.0
6	9.1
7	8.2
8	7.3
9	6.5
10	5.7
11	5.0
12	4.4
13	3.8
14	3.3
15	2.8
16	2.5
17	2.2
18	1.9
19	0.0

For the first N years:

$$kWh_{savings} = Rated\ Horsepower\ \times Conversion\ Factor\ \times LF\ \times \left(\frac{1}{\eta_{baseline}} - \frac{1}{\eta_{post}}\right) \times hours$$

$$kW_{reduction} = Rated\ Horsepower\ \times Conversion\ Factor\ \times LF\ \times \left(\frac{1}{\eta_{baseline}} - \frac{1}{\eta_{post}}\right) \times CF$$

Where:

$Rated\ HorsePower$ = Nameplate horsepower data of the motor

$Conversion\ Factor$ = 0.746 kW/hp

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[222] Because the motor EUL is 15 years, it is consistent for use with the RUL determined using the Weibull distribution offered in the DOE's Life Cycle Cost Analysis Spreadsheet, "lcc_cuac_hourly.xls".

http://www1.eere.energy.gov/buildings/appliance_standards/standards_test_procedures.html.

[223] Use of the early retirement baseline is capped at 18 years, representing the age at which 75 percent of existing equipment is expected to have failed. Systems older than 18 years should use the ROB baseline.

$\boldsymbol{LF}$= Estimated load factor for the motor; if load factor is not available, deemed load factors in Table 111 can be used

$\boldsymbol{\eta_{baseline}}$= In situ efficiency of the baseline motor; if unavailable, efficiencies listed in

can be used (in the case of rewound motors, in situ efficiency may be reduced by a percentage as found in Table 115).

η_{post}=Efficiency of the newly installed motor

Hours= Estimated annual operating hours for the motor; if unavailable, annual operational hours in Table 111 can be used

CF = Coincidence Factor = 0.74[224]

Table 115: Rewound Motor Efficiency Reduction Factors[225]

Motor Horsepower	*Efficiency Reduction Factor*
<40	0.01
≥40	0.005

For Years EUL - N through EUL:

Savings should be calculated exactly as they are for replace on burnout projects, referred to as $kWh_{SavingsROB}$.

Total lifetime savings for early retirement projects are then determined by adding the savings calculated under the two preceding equations as follows:

$$Lifetime\ kWh\ savings\ for\ Early\ Retirement\ Projects = \left(kWh_{savingsRUL} \times RUL\right) + \left[kWh_{savingsROB} \times (EUL - RUL)\right]$$

Where:

RUL= The Remaining Useful Life of the equipment, in years, see Table 114.

224 Itron 2004-2005 DEER Update Study, Dec 2005; Table 3-25. http://www.deeresources.com/deer2005/downloads/DEER2005UpdateFinalReport_ItronVersion.pdf. Accessed May 2013.

225 U.S. DOE, Preliminary Technical Support Document, "Energy Efficiency Program for Commercial Equipment: Energy Conservation Standards for Electric Motors, 2.7.2 Impact of Repair on Efficiency." July 23, 2012. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/50. Download TSD at: http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/em_preanalysis_tsdallchapters.pdf .

EUL = The Estimated Useful Life of the equipment, deemed at 15 years

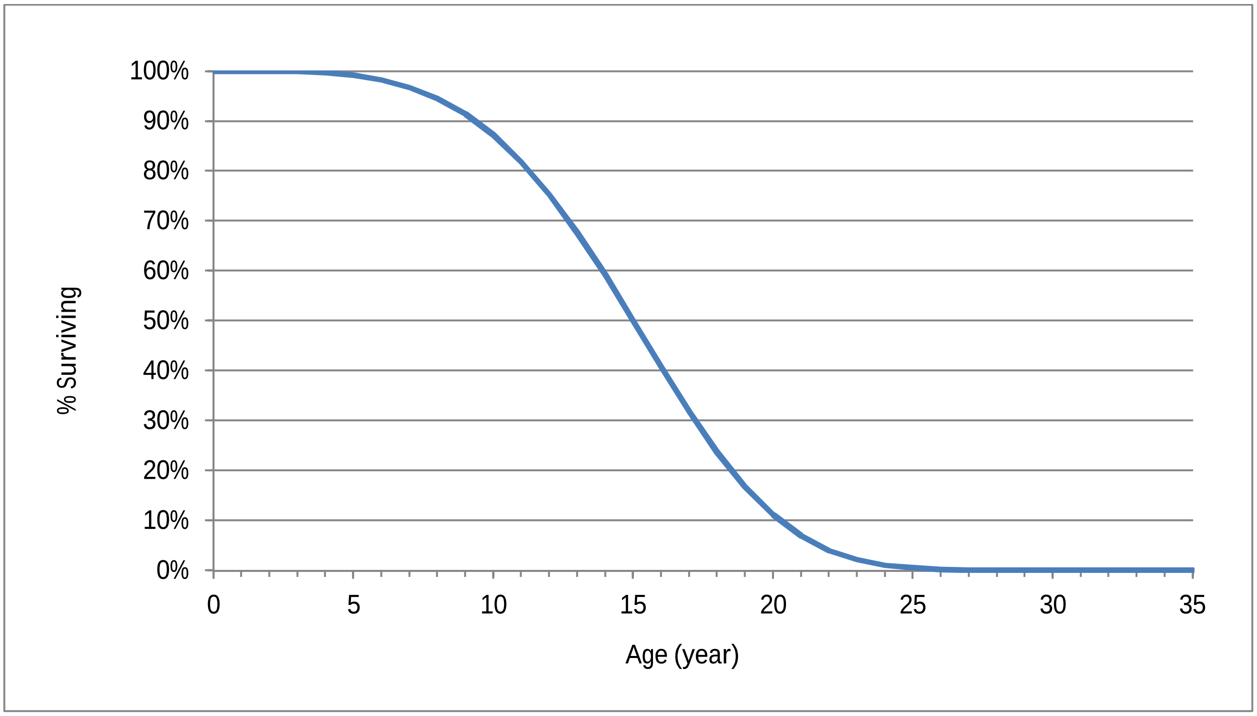

Figure 2: Survival Function for Premium Efficiency Motors[226]

The method used for estimating the RUL of a replaced system uses the age of the existing system to re-estimate the survival function shown in Figure 2. The age of the system being replaced is found on the horizontal axis and the corresponding percentage of surviving systems is determined from the chart. The surviving percentage value is then divided in half, creating a new percentage. Then the age (year) that corresponds to this new percentage is read from the chart. RUL is estimated as the difference between that age and the current age of the system being replaced.

C.1.2.5. Incremental Cost

Table 116: Motor Incremental Cost by Size[227]

[226] Source: Weibull distribution based on the Life Cycle Cost Analysis Spreadsheet, "lcc_cuac_hourly.xls".

http://www1.eere.energy.gov/buildings/appliance_standards/standards_test_procedures.html.

Motor Horsepower	*Incremental Cost*
5	$918
7.5	$918
10	$918
15	$918
20	$933
25	$1,012
30	$1,091
40	$1,300
50	$1,497
60	$1,796
75	$1,943
100	$2,389
125	$3,087
150	$3,784
200	$4,555
250	$4,655
300	$4,755
350	$4,855
400	$4,955
450	$5,055
500	$5,155

C.1.2.6. Future Studies

In Energy Smart and other utility portfolios, this is typically a low-volume measure. High-saving motor applications are more commonly found in custom applications. As a result, ADM does not advise funding future measure research, and recommend that the measure receive updated only when applicable codes or standards warrant it.

[227] Comprehensive Process and Impact Evaluation of the (Xcel Energy) Colorado Motor and Drive Efficiency Program, FINAL, March 28, 2011,TetraTech

C.2. Commercial Water Heating

C.2.1. Water Heater Replacement

C.2.1.1. Measure Description

This measure involves:

- The replacement of electric water heaters in commercial buildings by high efficiency electric resistance water heaters
- The replacement of electric water heaters in commercial buildings by heat pump water heaters
- The replacement of small (< 12 kW) electric water heaters in commercial buildings by electric tankless water heaters

Commercial water heater savings are measured per location and are calculated for new construction or replace-on-burnout. Storage tank models and tankless models, utilizing electricity are eligible.

C.2.1.2. Baseline and Efficiency Standards

The baseline standards for IECC 2009 are detailed in Table 117.

Table 117: Commercial Water Heaters – Water Heater Performance Requirements

Equipment Type	***Size Category (Input)***	***Subcategory or Rating Condition***	***Performance Required[228],[229]***	***Test Procedure***
Water heaters, electric	≤ 12 kW	Resistance	IECC 2009: 0.97 - 0.00132V, EF	DOE 10 CFR Part 430
	> 12 kW		1.73V + 155, SL (Btu/hr)	ANSI Z21.10.3
	≤ 24 amps and ≤ 250 volts	Heat Pump	0.93 - 0.00132V, EF	DOE 10 CFR Part 430

For smaller water heaters where energy factor (EF) is used, EF takes into account the overall efficiency, including combustion efficiency and standby loss (SL). Regulated by DOE as "residential water heaters", these smaller water heaters

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[228] Energy factor (EF) and thermal efficiency (E_t) are minimum requirements. In the EF equation, V is the rated volume in gallons.

[229] Standby loss (SL) is the maximum Btu/hr based on a nominal 70°F temperature difference between stored water and ambient requirements. In the SL equation, Q is the nameplate input rate in Btu/hr. In the SL equation for electric and gas water heaters and boilers, V is the rated volume in gallons.

manufactured on or after April 16, 2015 must comply with the amended standards found in the Code of Federal Regulations, 10 CFR 430.32(d), detailed in Table 118.

Table 118: Small Commercial Water Heaters – Standards and their Compliance Dates[230]

Product Class	Energy Factor as of April 16, 2015
Electric Water Heater	For Vs < 55 gallons: 0.960 – (0.0003V) For Vs > 55 gallons: 2.057 – (0.00113V)

For larger water heaters, thermal efficiency (Et) is used and does not factor into SL; however, a limitation on SL is noted.

The savings calculations consider the minimum water heater efficiency requirements listed in Table 117 to be the baseline.

C.2.1.3. Estimated Useful Life (EUL)

The estimated useful life (EUL) of this measure is dependent on the type of water heating. According to DEER 2014, the following measure lifetimes should be applied.[231]

- 10 years for Heat Pump Water Heater (HPWH)
- 15 years for High Efficiency Commercial Storage Water Heater
- 20 years for Commercial Tankless Water Heater

C.2.1.4. Deemed Savings Values

Program staff should endeavor to collect unit-specific information to support energy savings calculations. However, if such data is not available the tables below may be used. The assumptions are as follows:

- Electric Resistant Water Heating:
  - Assume full facility load met by a series of 50-gallon units
  - Resulting baseline EF is .945
  - Efficient EF is .98
- Heat Pump Water Heating:
  - Assume full facility load met by a series of 200-gallon units
  - Resulting baseline EF is 2.00

[230] Where V is the rated storage volume, which equals the water storage capacity of a water heater (in gallons), as certified by the manufacturer.

[231] http://www.deeresources.com/files/deer2008exante/downloads/EUL_Summary_10-1-08.xls

- Efficient EF is 2.20

Table 119: Deemed Savings: Electric Resistant Water Heaters

Building Type	Annual Hot Water / 1,000 ft.²	Average ft.²	kWh Savings	kW Savings
Convenience Store	4,255	2,800	50	0.0057
Education	6,746	45,000	1,267	0.1446
Grocery	646	21,300	57	0.0065
Health	22,734	72,000	6,829	0.7796
Large Office	1,686	95,000	668	0.0763
Large Retail	1,254	80,000	419	0.0478
Lodging	27,399	76,500	8,745	0.9983
Nursing	28,279	72,000	8,495	0.9697
Restaurant	41,224	3,850	662	0.0756
Small Office	1,428	6,000	36	0.0041
Small Retail	5,660	6,400	151	0.0172
Warehouse	1,148	14,000	67	0.0076
Other Commercial	3,652	4,000	61	0.0070

Table 120: Deemed Savings: Heat Pump Water Heaters

Building Type	Annual Hot Water / 1,000 ft.²	Average ft.²	kWh Savings	kW Savings
Convenience Store	4,255	2,800	60	0.0068
Education	6,746	45,000	1,523	0.1739
Grocery	646	21,300	69	0.0079
Health	22,734	72,000	8,214	0.9376
Large Office	1,686	95,000	804	0.0917
Large Retail	1,254	80,000	503	0.0575
Lodging	27,399	76,500	10,518	1.2007
Nursing	28,279	72,000	10,217	1.1663
Restaurant	41,224	3,850	796	0.0909
Small Office	1,428	6,000	43	0.0049
Small Retail	5,660	6,400	182	0.0207
Warehouse	1,148	14,000	81	0.0092
Other Commercial	3,652	4,000	73	0.0084

C.2.1.5. Calculation of Deemed Savings

Typically, two types of ratings exist for water heaters: energy factor (EF) for smaller units, and thermal efficiency (Et) for larger water heaters. Large heat pump water heaters may also be rated by a third method, coefficient of performance (COP), which is the ratio of heat energy output to electrical energy input, and is analogous to thermal efficiency. EF includes standby losses, while Et and COP only consider the amount of energy required to heat the water. Therefore, in the formulas below, the baseline and energy efficiency measure may be compared for each type of water heater.

The electricity savings for this measure are highly dependent on the estimated hot water consumption, which varies significantly by building type. The following tables list estimated hot water consumption for various building types by number of units, occupants, or building size.

Table 121: Hot Water Requirements by Building Type and System Capacity[232]

Building Type	***Annual Hot Water Consumption Per Gallon of Rated Capacity***
Convenience Store	489
Education	526
Grocery	489
Health	730
Large Office	474
Large Retail	489
Lodging	663
Nursing	623
Restaurant	577
Small Office	474
Small Retail	489
Warehouse	316
Other Commercial	316

[232] Methodology based on ADM analysis. Annual hot water usage in gallons based on CBECS (2012) and RECS (2009) consumption data of West South Central (removed outliers of 1,000 kBtuh or less) to calculate hot water usage. Annual hot water gallons per tank size gallons based on the tank sizing methodology found in ASHRAE 2011 HVAC Applications. Chapter 50 Service Water Heating. Demand assumptions (gallons per day) for each building type based on ASHRAE Chapter 50 and to LBNL White Paper. LBL-37398 Technology Data Characterizing Water Heating in Commercial Buildings: Application to End Use Forecasting. Assumes hot water heater efficiency of 80.

Table 122 converts the values from Table 121 into per-1,000 square feet value based on the same CBECS 2012 data.

Table 122: Hot Water Requirements by Building Size[233]

Building Type	Annual Hot Water Consumption Per 1,000 square feet
Convenience Store	4,255
Education	6,746
Grocery	646
Health	22,734
Large Office	1,686
Large Retail	1,254
Lodging	27,399
Nursing	28,279
Restaurant	41,224
Small Office	1,428
Small Retail	5,660
Warehouse	1,148
Other Commercial	3,652

C.2.1.5.1. Small Electric Storage Water Heaters

As small (≤ 12 kW) electric water heaters are typically rated by EF, this section of this measure includes both higher-efficiency resistance water heaters and small (≤ 24 amps and ≤ 250 volts) heat pump water heaters. Deemed annual energy savings for small electric water heater replacements are calculated by formulas as follows:

$$kWh_{Savings} = \frac{\rho \times C_p \times V \times (T_{SetPoint} - T_{Supply}) \times (EF_{pre} - EF_{post})}{3{,}412\ Btu/kWh}$$

Where:

ρ = Water density = 8.33 lb/gal

C_p = Specific heat of water = 1 BTU/lb·°F

[233] This is a conversion of the capacity values to a per-square foot value based on average building size in the CBECS.

V = Average annual hot water use (gallons). See for Table 121 and Table 122 estimates of water consumption.

$T_{SetPoint}$ = Water heater set point (default value = 120°F)

T_{Supply} = Average New Orleans area supply water temperature, 74.8°F[234]

EF_{pre} = Calculated energy factor of existing water heater, based on the water heater tank volume; Table 117.

EF_{post} = Energy Factor of replacement water heater (taken from nameplate); the replacement water heater may be either a high efficiency electric storage water heater or a heat pump water heater

$Conversion\ Factor$ = 3,412 Btu/kWh

Deemed demand savings for small electric water heater replacements are calculated by formula as follows:

$$kW_{reduction} = \frac{\rho \times C_p \times V \times (T_{SetPoint} - T_{Supply}) \times (EF_{pre} - EF_{post})}{3{,}412\ Btu/kWh} \times 1/24 \times 1/365$$

Where all variables are the same as in the energy equation and the average hourly ratio is a best estimate of peak coincidence for commercial hot water heater replacements.[235]

C.2.1.5.2. Large Electric Storage Water Heaters

Large (> 12 kW) electric resistance water heaters can be replaced with heat pump water heaters.

For replacement of large electric resistance water heaters with a heat pump water heater, deemed annual energy savings are calculated by the following formula:

$$kWh_{Savings} = \frac{\rho \times C_p \times GPD \times (T_{SetPoint} - T_{Supply}) \times \left(\frac{1}{E_{t,base}} - \frac{1}{COP_{post}}\right) \times Days/Year}{3{,}412\ Btu/kWh}$$

Where:

ρ = Water density = 8.33 lb/gal

C_p = Specific heat of water = 1 BTU/lb·°F

[234] Calculated using area groundwater data. See Section 0.

[235] For replacement with high-efficiency electric storage water heaters and tankless water heaters, the 1/24 peak coincidence factor accurately reflects that improvements in the efficiency of electric resistance storage water heaters are driven almost entirely by reductions in storage losses (conversion efficiency, RE, is close to 1), which are distributed evenly throughout the day.

V = Average daily hot water use (gallons). See Table 121 and Table 122 for estimates of water consumption

$T_{SetPoint}$ = Water heater set point (default value = 120°F)

T_{Supply} = Average New Orleans area supply water temperature, 74.8°F

$E_{t,base}$ = .98

COP_{post} = Coefficient of performance of new heat pump water heater

C.2.1.5.3. Demand Savings

Deemed demand savings for replacement of large electric resistance water heaters with a heat pump water heater are calculated by the following formula:

$$kW_{reduction} = \frac{\rho \times C_p \times GPD \times (T_{SetPoint} - T_{Supply}) \times (EF_{pre} - EF_{post})}{3{,}412\ Btu/kWh} \times 1/24$$

Where all variables are the same as in the energy equation and the 1/24 ratio is a best estimate of peak coincidence for commercial hot water heater replacements.

C.2.1.5.4. Incremental Cost

The incremental cost for heat pump water heaters are as follows[236]:

- 50 Gallon: $1,050
- 80 Gallon: $1,050
- 100 Gallon: $1,950

C.2.1.1. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using ENERGY STAR default values. If this measure is added to Energy Smart programs, the evaluation should include a review of actual efficiency levels and costs of units purchased by New Orleans businesses and updates for applicable codes.

Current DHW load estimates are based off of CBECS data for the West South region. If there is significant participation, we recommend updating with actual participant loads. Further, a study of commercial DHW setpoints would be warranted.

[236] Cost information is based upon data from “2010-2012 WA017 Ex Ante Measure Cost Study Draft Report”, Itron, February 28, 2014. See “NR HW Heater_WA017_MCS Results Matrix - Volume I.xls” for more information.

C.2.2. Commercial Faucet Aerators

C.2.2.1. Measure Description

This measure consists of installing low-flow faucet aerators in commercial facilities which reduce water usage and save energy associated with heating the water.

C.2.2.2. Baseline and Efficiency Standards

The savings values for low-flow faucet aerators are for the retrofit of existing operational faucet aerators with a flow rate of 2.2 gallons per minute or higher. Facilities that use both gas and electric water heaters are eligible for this measure.

The baseline faucet aerators are assumed to have a flow rate of 2.2 gallons per minute.[237] To qualify for this measure, the flow rate of installed low-flow faucet aerators must be at most 1.5 gallon per minute.[238]

C.2.2.3. Estimated Useful Life (EUL)

The average lifetime of this measure is 10 years, according to DEER 2014.

C.2.2.4. Deemed Savings

Table 123 through Table 125 present the default savings for 1.5, 1.0, and 0.5 GPM aerators, respectively. The results are presented by facility type, with the "unknown" category being an average of the listed facility types.

Table 123: Faucet Aerator Deemed Savings – 1.5 GPM

Building Type	***Days/Year***	***Minutes/Day***	***kWh Savings***	***kW Savings***
Hospital, Nursing home	365	3	86	0.0071
Dormitory	274	30	648	0.0946
Multifamily	365	3	86	0.0071
Lodging	365	3	86	0.0047
Commercial	250	30	591	0.1892
School	200	30	473	0.1183
Unknown	303	17	329	0.0702

[237] Maximum flow rate federal standard for lavatories and aerators set in Federal Energy Policy Act of 1992 and codified at 2.2 GPM at 60 psi in 10CFR430.32.

[238] "High-Efficiency Lavatory Faucet Specification." WaterSense. EPA. October 1, 2007. http://www.epa.gov/watersense/partners/faucets_final.html

Table 124: Faucet Aerator Deemed Savings – 1.0 GPM

Building Type	Days/Year	Minutes/Day	kWh Savings	kW Savings
Hospital, Nursing home	365	3	148	0.0122
Dormitory	274	30	1,111	0.1622
Multifamily	365	3	148	0.0122
Lodging	365	3	148	0.0081
Commercial	250	30	1,014	0.3244
School	200	30	811	0.2028
Unknown	303	17	563	0.1203

Table 125: Faucet Aerator Deemed Savings – 0.5 GPM

Building Type	Days/Year	Minutes/Day	kWh Savings	kW Savings
Hospital, Nursing home	365	3	210	0.0172
Dormitory	274	30	1,574	0.2298
Multifamily	365	3	210	0.0172
Lodging	365	3	210	0.0115
Commercial	250	30	1,436	0.4596
School	200	30	1,149	0.2873
Unknown	303	17	798	0.1704

C.2.2.5. Calculation of Deemed Savings

Annual kWh electric and peak kW savings can be calculated using the following equations:

$$kWh\ Savings = \frac{\rho \times C_P \times U \times (F_B - F_P) \times \left(T_H - T_{Supply}\right) \times \frac{1}{E_t} \times Days/Year}{3{,}412\ Btu/kWh}$$

$$kW_{reduction} = \frac{\rho \times C_P \times U \times (F_B - F_P) \times \left(T_H - T_{Supply}\right) \times \frac{1}{E_t} \times P}{3{,}412\ Btu/kWh}$$

Table 126: Commercial Aerator Savings Parameters

Parameter	Description	Value
F_B	Average baseline flow rate of aerator (GPM)	2.2
F_P	Average post measure flow rate of aerator (GPM)	≤1.5
Days/Year	Annual Building type operating days for the applications:	
	1.Hospital, Nursing home	365
	2. Dormitory	274[239]
	3. Multifamily	365
	4. Lodging	365
	5. Commercial	250
	6. School	200
T_{supply}	Average supply (cold) water temperature (ºF)	74.8
T_H	Average mixed water (after aerator) temperature (ºF)	120[240]
U	Baseline water usage duration, following applications	
	1. Hospital, Nursing home	3 min/day/unit
	2. Dormitory	30 min/day/unit
	3. Multifamily	3 min/day/unit
	4. Lodging	3 min/day/unit
	5. Commercial	30 min/day/unit
	6. School	30 min/day/unit
ρ	Unit conversion: 8.33 pounds/gallon	8.33
C_p	Heat capacity of water - 1 Btu/lb ºF	1
E_t	Thermal Efficiency of water heater	Default Values: 0.98 for electric resistance, 2.2 (COP) for heat pump
	Hourly water consumption during peak period as a fraction of average daily consumption for applications:	
	1. Hospital, Nursing home	0.03
	2. Dormitory	0.04
	3. Multifamily	0.03
	4. Lodging	0.02

239 Dormitories with few occupants in the summer: 365 x (9/12) = 274.

240 Calculated based on area groundwater temps.

	5. Commercial	0.08
	6. School	0.05

Example: The following is an electric example calculation for a 1.0 GPM aerator replacement for a school using the previous equations and information. Example electric savings are based on heating water with a conventional electric resistance storage tank water heater.

$\Delta kWh = [8.33\ x\ 30 minday\ x\ (2.2-1.0)\ GPM\ x\ (120-74.8°F)\ x\ (1/.98) * 200 dayyear]/3412\ Btu/kWh = 811\ kWh$

$\Delta kW = [8.33\ x\ 30 minday\ x\ (2.2-1.0)\ GPM\ x\ (120-74.8°F)\ x\ (1/.98)\ x\ .05]/3412\ Btu/kWh = 0.202\ kW$

C.2.2.6. Incremental Cost

Program-actual costs should be used where available. If not available, the incremental cost of a faucet aerator is $8.00[241].

C.2.2.1. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using ENERGY STAR default values. If this measure is added to Energy Smart programs, the evaluation should include a review of actual efficiency levels and costs of units purchased by New Orleans businesses and updates for applicable codes.

If there is significant participation, we recommend updating with actual participant loads. Further, a study of commercial DHW setpoints would be warranted.

[241] Direct-install price per faucet assumes cost of aerator and install time. (2011, Market research average of $3 and assess and install time of $5 (20min @ $15/hr)

C.2.3. Commercial Low-Flow Showerheads

C.2.3.1. Measure Description

This measure consists of removing existing showerheads and installing low-flow showerheads at the following commercial building types: hospitals and nursing homes, lodging facilities, commercial facilities (offices or other commercial buildings in which showers are provided for employees), fitness centers, and schools.[242]

C.2.3.2. Baseline and Efficiency Standards

The savings values for low-flow showerheads are for the retrofit of existing operational showerheads with a flow rate of 2.5 gallons per minute (GPM) or higher.[243] Facilities must have electric water heating to qualify for this measure.

The baseline showerhead has an average flow rate of 2.5 GPM based on the current DOE standard. To qualify for the deemed savings, replacement showerheads must have a flow rate of 2.0 GPM or less.[244]

Existing showerheads that have been defaced so as to make the flow rating illegible are not eligible for replacement. Low flow shower heads that are easily tampered with should not be used. Removed showerheads shall be collected by the contractor and held for possible inspection by the utility until all inspections for invoiced installations have been completed.

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[242] This measure draws from multiple sources, including the residential low flow showerhead measure and commercial faucet aerator measure. Information specific to hot water use in commercial market sectors was drawn from CLEAResult, Inc. draft white paper: *Work Papers for Low Flow Shower Heads with Gas or Electric Water Heaters: Savings Calculation Methodology for Application in Arkansas Energy Efficiency Programs*, February 2014.

[243] 10 CFR Part 430, Energy Conservation Program for Consumer Products: Test Procedures and Certification and Enforcement Requirements for Plumbing Products; and Certification and Enforcement Requirements for Residential Appliances; Final Rule, March 1998. Online. Available: http://www.regulations.gov/#!documentDetail;D=EERE-2006-TP-0086-0003.

[244] The U.S. Environmental Protection Agency (EPA) WaterSense Program has a thorough specification for showerheads that meet a maximum flow rate of 2.0 gpm. The specification is available on the EPA website at: www.epa.gov/WaterSense/partners/showerhead_spec.html

Table 127: Low-Flow Showerhead – Baseline and Efficiency Standards

Measure	New Showerhead Flow Rate[245] (GPM)	Existing Showerhead Baseline Flow Rate (GPM)
2.0 GPM showerhead	2.0	2.5
1.75 GPM showerhead	1.75	2.5
1.5 GPM showerhead	1.5	2.5

The U.S. Environmental Protection Agency (EPA) WaterSense Program has implemented efficiency standards for showerheads requiring a maximum flow rate of 2.0 GPM[246].

C.2.3.3. Estimated Useful Life (EUL)

The average lifetime of this measure is 10 years, according to DEER 2014.

C.2.3.1. Deemed Savings

Table 128 through Table 130 present the default savings for 1.5, 1.0, and 0.5 GPM aerators, respectively. The results are presented by facility type, with the "unknown" category being an average of the listed facility types. For the "unknown" facility type, the values are the average of all other facilities excluding Fitness Center; this facility is a high outlier in savings and ADM has opted to exclude it from the "unknown" category due to the risk of this facility skewing results.

Table 128: Showerhead Deemed Savings – 2.0 GPM

Building Type	Hot Water Reduction	kWh Savings	kW Savings
Hospital / Nursing home	232	25.61	0.0021
Hospitality	326	35.99	0.0020
Commercial (General) - Employee Shower	253	27.93	0.0089
Fitness Center	5203	574.38	0.1259
Schools	344	37.98	0.0095
Unknown	288.75	31.88	0.0056

[245] All flow rate requirements listed here are the rated flow of the showerhead measured at 80 pounds per square inch of pressure (psi).

[246] http://www1.eere.energy.gov/femp/program/waterefficiency_bmp7.html.

Table 129: Showerhead Deemed Savings – 1.75 GPM

Building Type	Hot Water Reduction	kWh Savings	kW Savings
Hospital / Nursing home	348	38.42	0.0032
Hospitality	489	53.98	0.0030
Commercial (General) - Employee Shower	380	41.95	0.0134
Fitness Center	7,804	861.52	0.1888
Schools	517	57.07	0.0143
Unknown	433.5	47.86	0.0085

Table 130: Showerhead Deemed Savings – 1.5 GPM

Building Type	Hot Water Reduction	kWh Savings	kW Savings
Hospital / Nursing home	464	51.22	0.0042
Hospitality	652	71.98	0.0039
Commercial (General) - Employee Shower	506	55.86	0.0179
Fitness Center	10,405	1,148.66	0.2518
Schools	689	76.06	0.0190
Unknown	577.75	63.78	0.0113

C.2.3.2. Calculation of Deemed Savings

Energy and demand savings are estimated as functions of the reduction in daily water use (ΔV) attributable to installation of low flow showerheads in a given commercial building type. Reduction in water use and deemed savings calculations make use of the data provided by building type in Table 131 and the New Orleans average water main temperature, 74.8.

Table 131: Showers per Day (per Showerhead) and Days of Operation by Building Type

Building Type	Showers/Day	Days/Year
Hospital/Nursing home	0.89	365
Hospitality	1.25	365
Commercial	0.97	250
Fitness Center	19.94	365
School	1.32	200

C.2.3.3. Estimated Hot Water Usage Reduction

Reduction in annual hot water usage is estimated based on the typical duration of a shower and the expected number of showers per year for an installed showerhead in a given facility.

Reduction in daily hot water consumption is estimated on a per-showerhead basis using the following formula:

$$\Delta V = U \times N \times (Q_B - Q_P) \times F_{HW}$$

Where:

ΔV = Reduction in daily hot water use in gallons per day (GPD)

U = Typical shower duration of 7.8 (minutes/shower)

N = Number of showers per day (per showerhead); (N) is a function of the commercial building type, values for N are provided in Table 133.

Q_B = Baseline showerhead flow rate, 2.5 GPM

Q_P = Flow rate of installed showerhead (in GPM)

F_{HW} = Hot Water Fraction (share of water flowing through showerhead from the water heater, %)

The fraction of hot water is a function of the inlet water temperature (T_{supply}) the temperature of water from the hot water heater (T_{HW} = 120 □F), and the desired temperature at the showerhead (T_{mixed} = 105 □F).

Reduction in daily hot water usage is provided for reference in Table 132.

Table 132: Reduction in Daily Hot Water Usage, ΔV (GPD)

Flow Rate of installed showerhead	Building Type				
	Hospital / Nursing home	Hospitality	Commercial (General) - Employee Shower	Fitness Center	Schools
2.0 GPM	232	326	253	5,203	344
1.75 GPM	348	489	380	7,804	517
1.5 GPM	464	652	506	10,405	689

C.2.3.3.1. Energy Savings

The deemed energy savings are calculated as follows:

$$kWh_{savings} = \frac{\rho \times C_P \times \Delta V \times (T_{HW} - T_{Supply}) \times \left(\frac{1}{E_t}\right)}{Conversion\ Factor} \times \frac{days}{year}$$

Where:

ρ = Water density = 8.33 lb/gallon

C_P = Specific heat of water = 1 Btu/lb·°F

ΔV = gallons of hot water saved per day (GPD, calculated above identified in Table 132)

T_{HW} = Temperature to which water is heated in the water heater, 120°F

T_{Supply}= Average inlet water temperature (water mains temperature), 74.8.

E_t = Thermal efficiency of water heater (or in the case of heat pump water heaters, COP); if unknown, use 0.98 as a default for electric resistance water heaters, 2.2 for heat pump water heaters[247]

$Conversion\ Factor$ = 3,412 Btu/kWh for electric water heating or 100,000 Btu/therm for gas water heating

$days/year$ = annual operating days for the building type in which the retrofit is being implemented (see Table 131).

C.2.3.3.2. Demand Savings

The deemed demand savings are calculated as follows:

$$kW_{reduction} = \frac{\rho \times C_P \times \Delta V \times (T_{HW} - T_{Supply}) \times \left(\frac{1}{E_t}\right)}{Conversion\ Factor} \ x\ P$$

Where:

All inputs are the same as described in the Energy Savings Equation and

P = electric peak coincidence factors, as provided for each building type in Table 133.[248]

[247] Default values based on median recovery efficiency of commercial water heaters by fuel type in the AHRI database as cited in previous iterations of the AR TRM. Online: available at http://cafs.ahrinet.org/gama_cafs/sdpsearch/search.jsp?table=CWH.

C.2.3.3.3. Parameters for Annual Energy and Peak Demand Savings Calculations

Table 133: Parameters for Annual Energy and Peak Demand Savings Calculations

Parameter	Description	Value
U	Baseline shower duration[249] (min/shower)	7.8
N	Number of showers per day per showerhead[250] 1. Hospital, Nursing Home 2. Lodging 3. Commercial 4. 24-Hour Fitness Center 5. Schools	 0.89 1.25 0.97 19.94 1.32
Q_B	Average baseline flow rate of showerhead (GPM)	2.5
Q_P	Flow rate of installed showerhead (GPM)	≤ 2.0
F_{HW}	Share of water flowing through showerhead coming from the water heater (%)	66.9
ρ	Density of water (lb/gal)	8.33
Cp	Heat capacity of water (Btu/lb-ºF)	1
T_{HW}	Temperature to which water is heated by the water heater (ºF)[251]	120
T_{supply}	Average supply (cold) water temperature (ºF)	74.8

[248] For all building types except 24-Hour Fitness Centers, derived from *ASHRAE Handbook 2011. HVAC Applications.* American Society of Heating Refrigeration and Air Conditioning Engineers, Inc. (ASHRAE) 2011. ASHRAE, Inc., Atlanta, GA. The peak factor is the ratio of the gallons of hot water used during the peak times of 3pm to 6pm, to the total amount of hot water used during the day. 24-Hour Fitness Center is assigned the same value as Commercial.

[249] Hendron, R., & Engebrech, C. 2010, "*Building America Research Benchmark Definition, Updated December 2009, Technical Report NREL/TP-550-47246,* January. National Renewable Energy Laboratory The average shower duration taken from Table 12, p. 20.

[250] Primary source is Northwest Power and Conservation Council ProCost V2.3. The number of showers per day per showerhead is back-calculated for hospitals and nursing homes, lodging and commercial building types, coefficients from annual minutes per showerhead estimates. N = (Minutes/year) x (year/days) x (Shower/minutes) = Showers/day. For 24-hour fitness centers, minutes per year were taken from informal telephone survey of Fitness Centers in the Northwest, conducted by Northwest Power and Conservation Council Regional Technical Forum staff in June, 2013. The estimate for schools is derived from Water consumption from Planning and Management Consultants, Ltd., Aquacraft, Inc. and John Olaf Nelson, Water Resources Management. "*Commercial and Institutional End Uses of Water,"* American Water Works Association Research Foundation, 2000.

[251] ASHRAE Handbook 2011. HVAC Applications. American Society of Heating Refrigeration and Air Conditioning Engineers, Inc. (ASHRAE), Inc., Atlanta, GA.

Parameter	Description	Value
E_t	Thermal Efficiency of hot water heater: ▪ Conventional Electric Storage Water Heater ▪ Heat Pump Water Heater (COP) ▪ Gas Storage Water Heater	 0.98 2.2 0.80
$Days/year$	Annual building type operating days for the applications:[252] 1. Hospital, Nursing Home 2. Lodging 3. Commercial 4. 24-Hour Fitness Center 5. School	 365 365 250 365 200
P	Peak Factor:[253] 1. Hospital, Nursing Home 2. Lodging 3. Commercial 4. 24-Hour Fitness Center 5. School	 0.03 0.02 0.08 0.08 0.05

C.2.3.4. Incremental Cost

Program-actual costs should be used where available. If not available, the incremental cost of a low flow showerhead is $12.00[254].

C.2.3.1. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using ENERGY STAR default values. If this measure is added to Energy Smart programs, the evaluation should include a review of actual efficiency levels and costs of units purchased by New Orleans business and updates for applicable codes.

If there is significant participation, we recommend updating with actual participant loads. Further, a study of commercial DHW setpoints would be warranted.

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[252] All values except 24-Hour Fitness Center from Osman , S. & Koomey, J. Lawrence Berkeley National Laboratory 1995. *Technology Data Characterizing Water Heating in Commercial Buildings: Application to End-Use Forecasting.* December 1995. Value for 24-Hour Fitness Center based on observation.

[253] Derived from *ASHRAE Handbook 2011. HVAC Applications.* American Society of Heating Refrigeration and Air Conditioning Engineers, Inc. (ASHRAE) 2011. ASHRAE, Inc., Atlanta, GA. The peak factor is the ratio of the gallons of hot water used during the peak times of 3 pm to 6pm, to the total amount of hot water used during the day.

[254] Direct-install price per showerhead assumes cost of showerhead (Market research average of $7 and assess and install time of $5 (20min @ $15/hr)

C.2.4. Commercial Water Heater Pipe Insulation

C.2.4.1. Measure Description

This measure consists of installing water heater pipe insulation exceeding the IECC mandated standard (0.5-inch of insulation that delivers an R-value of at least 3.7 per inch) over at least the first 8 feet of exposed pipe in small commercial settings. Water heaters plumbed with heat traps or automatic-circulating systems are not eligible to receive incentives for this measure.[255]

C.2.4.2. Baseline and Efficiency Standards

Baseline insulation is R = 1.85 sq. ft. h °F/Btu, the mandated standard since IECC 2000.

C.2.4.3. Estimated Useful Life (EUL)

The estimated useful life (EUL) of this measure is the remaining service life of the water heater. If unknown, use one-third of the life of an electric resistant water heater, rounded down. This is a measure life of 4 years.[256]

C.2.4.4. Deemed Savings Values

ADM assumes three feet of R-3 insulation in providing an estimate of per-project savings. Program administrators are encouraged to incorporate facility-specific inputs when possible. Deemed savings are:

- 112 kWh;
- .0128 kW

C.2.4.5. Calculation of Deemed Savings

C.2.4.5.1. Energy Savings

$$kWh_{savings} = (U_{pre} - U_{post}) \times A \times (T_{Pipe} - T_{ambient}) \times \left(\frac{1}{E_t}\right) \times \frac{Hours_{Total}}{Conversion\ Factor}$$

Where:

U_{pre}= 1/(2.03[257]) = 0.49 BTU/h sq. ft. degree F

U_{post}= 1/(2.03+$R_{Insulation}$)

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[255] A survey of several large online home-improvement retailers shows three general classes of commercially available pipe insulation: one around R-2.3 (typically 5/8" thick foam), another around R-3 (typically 1/2" thick rubber) and lastly high-end insulation in the R-6 to R-7 range (1" thick rubber).

[256] To see water heater EUL, go to Section C.2.1.3.

[257] 2.03 is the R-value representing the film coefficients between water and the inside of the pipe and between the surface and air. *Mark's Standard Handbook for Mechanical Engineers, 8th edition*.

$R_{Insulation}$= R-value of installed insulation

A = Surface area in square feet (πDL) with L (length) and D pipe diameter in feet

T_{Pipe}(°F) = Average temperature of the pipe. Default value = 90 °F (average temperature of pipe between water heater and the wall)

$T_{ambient}$(°F) = 68.78°F (New Orleans TMY3 average hourly temperature)

Et = Thermal efficiency (or in the case of heat pump water heaters, COP); if unknown, use 0.98 as a default for electric water heaters, 2.2 for a heat pump water heater.[258]

$Hours_{Total}$ = 8,760 hr per year[259,260]

$Conversion\ Factor$ = 3,412 Btu/kWh for electric water heating or 100,000 Btu/Therm for gas water heating.

For example, deemed savings for water heater pipe insulation with an R-value of 3 installed on an electric water heater in New Orleans would be:

$$kWh_{savings} = (0.49 - 0.20) \times 2.1 \times (90 - 74.8) \times \left(\frac{1}{0.98}\right) \times \frac{8{,}760}{3{,}412} = 24.3\ kWh/yr$$

C.2.4.5.2. Demand Savings

Peak demand savings for hot water heaters installed in conditioned space can be calculated using the following formula for electric demand savings:

$$kW_{reduction} = \left(U_{pre} - U_{post}\right) \times A \times \left(T_{Pipe} - T_{ambientMAX}\right) \times \left(\frac{1}{E_t}\right) \times \frac{1}{3{,}412\ Btu/kWh}$$

Where:

U_{pre} = 1/(2.03) =0.49 BTU/h sq. ft. degree F

U_{post} = 1/(2.03+$R_{Insulation}$)

[258] Default values based on median recovery efficiency of residential water heaters by fuel type in the AHRI database, at https://www.ahridirectory.org/ahridirectory/pages/rwh/defaultSearch.aspx

[259] Ontario Energy's Measures and Assumptions for Demand Side Management (DSM) Planning www.ontarioenergyboard.ca/OEB/_Documents/EB-2008-0346/Navigant_Appendix_C_substantiation_sheet_20090429.pdf

[260] New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs Residential, Multi-Family, and Commercial/Industrial Measures http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/06f2fee55575bd8a852576e4006f9af7/$FILE/TechManualNYRevised10-15-10.pdf

$R_{Insulation}$ = R-value of installed insulation

A = Surface area in square feet (πDL) with L (length) and D pipe diameter in feet

T_{Pipe}(°F) = Average temperature of the pipe. Default value = 90 °F (average temperature of pipe between water heater and the wall)

$T_{ambientMAX}$(°F) =For water heaters installed in unconditioned basements, use an average ambient temperature of 68.78°F; for water heaters inside the thermal envelope, use an average ambient temperature of 78 °F

Et = Thermal efficiency (or in the case of heat pump water heaters, COP); if unknown, use 0.98 as a default for electric water heaters, 2.2 for a heat pump water heater.

C.2.4.6. Incremental Cost

The incremental cost of a Water Heater Pipe Insulation is equal to the full installed cost. If the cost is unknown, use $4.45 for ¾" pipe and $4.15 for ½" pipe per linear foot of insulation[261].

C.2.4.1. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using ENERGY STAR default values. If this measure is added to Energy Smart programs, the evaluation should include a review of actual efficiency levels and costs of units purchased by New Orleans businesses and updates for applicable codes.

[261] Illinois TRM

C.3.1. Packaged Terminal AC/HP (PTAC/PTHP) Equipment

C.3.1.1. Measure Description

This measure requires the installation of a PTAC or PTHP. AHRI Test Standard 310/380-2004 defines a PTAC or PTHP as "a wall sleeve and a separate non-encased combination of heating and cooling assemblies specified by the manufacturer and intended for mounting through the wall. It includes refrigeration components, separable outdoor louvers, forced ventilation, and heating availability by purchaser's choice of, at least, hot water, steam, or electrical resistance heat." These definitions are consistent with federal code (10 CFR Part 431.92).

PTAC/PTHP equipment is available in standard and non-standard sizes. Standard size refers to PTAC/PTHP equipment with wall sleeve dimensions having an external opening greater than or equal to 16 inches high or greater than or equal to 42 inches wide, and a cross-sectional area greater than or equal to 670 square inches. Non-standard size refers to PTAC/PTHP equipment with existing wall sleeve dimensions having an external wall opening of less than 16 inches high or less than 42 inches wide, and a cross-sectional area less than 670 square inches.

C.3.1.2. Baseline and Efficiency Standards

The baseline for units that are used in new construction or are replaced on burnout is the current federal minimum standard,[262] which went into effect September 30, 2012 for standard sized units and September 30, 2010 for non-standard sized units (Table 134).

Table 134: PTAC/PTHP Equipment – Baseline Efficiency Levels

Equipment Type	***Size Category***	***Capacity (Btu/h)***	***Minimum Efficiency*** [263]

[262] 2010 U.S. Code: Title 42, Chapter 77, Subchapter III, Part A-1, Section 6313.

Equipment Type	*Size Category*	*Capacity (Btu/h)*	*Minimum Efficiency* [263]
PTAC	Standard	< 7,000	EER = 11.7
		7,000 – 15,000	EER = 13.8 – (0.300 x CAP)
		> 15,000	EER = 9.3
	Non-Standard	< 7,000	EER = 9.4
		7,000 – 15,000	EER = 10.9 – (0.213 x CAP)
		> 15,000	EER = 7.7
PTHP	Standard	< 7,000	EER = 11.9 COP = 3.3
		7,000 – 15,000	EER = 14.0 – (0.300 x CAP) COP = 3.7 – (0.052 x CAP)
		> 15,000	EER = 9.5 COP = 2.9
	Non-Standard	< 7,000	EER = 9.3 COP = 2.7
		7,000 – 15,000	EER = 10.8 – (0.213 x CAP) COP = 2.9 – (0.026 x CAP)
		> 15,000	EER = 7.6 COP = 2.5

C.3.1.3. Estimated Useful Life (EUL)

The estimated useful life of the measure is 10 years, in accordance with the DOE's Packaged Terminal Air Conditioners and Heat Pumps Energy Conservation Standard Technical Support Document.[264]

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[263] "Cap" refers to cooling capacity in thousand Btu/h.

[264] U.S. DOE, Technical Support Document: "*Packaged Terminal Air Conditioners and Heat Pumps, 3.2.7 Equipment Lifetime".* http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/45.

C.3.1.4. Deemed Savings Values

For the deemed savings values, ADM assumes a Standard size category, and a capacity of 11,000 BTU (midpoint of the central size category) and a 12 EER/11 HSPF system.

Table 135: Deemed Savings by Building Type - PTAC

Building Type	***kWh***	***kW***
Fast Food	311	0.102
Grocery	200	0.118
Health Clinic	260	0.111
Large Office	194	0.110
Lodging	274	0.101
Full Menu Restaurant	262	0.111
Retail	418	0.115
School	305	0.093
Small Office	270	0.110
University	198	0.110
Unknown	269	0.1082

Table 136: Deemed Savings by Building Type - PTHP

Building Type	***kWh***	***kW***
Fast Food	293	0.087
Grocery	186	0.100
Health Clinic	234	0.095
Large Office	206	0.094
Lodging	276	0.086
Full Menu Restaurant	240	0.095
Retail	409	0.098
School	274	0.079
Small Office	256	0.094
University	231	0.094

Unknown	257	0.920

C.3.1.5. Calculation of Deemed Savings

Deemed peak demand and annual energy savings for PTAC/PTHP equipment should be calculated using the following formulas:

$$kW_{Savings} = CAP \times \frac{1\,kW}{1{,}000\,W} \times \left(\frac{1}{\eta_{base}} - \frac{1}{\eta_{post}}\right) \times CF$$

$$kWh_{Savings,PTAC} = CAP \times \frac{1\,kW}{1{,}000\,W} \times EFLH_C \times \left(\frac{1}{\eta_{base}} - \frac{1}{\eta_{post}}\right)$$

$$kWh_{Savings,PTHP,C} = CAP \times \frac{1\,kW}{1{,}000\,W} \times EFLH_C \times \left(\frac{1}{\eta_{base,C}} - \frac{1}{\eta_{post,C}}\right)$$

$$kWh_{Savings,PTHP,H} = CAP \times \frac{1\,kWh}{3{,}412\text{ BTU}} \times EFLH_H \times \left(\frac{1}{\eta_{base,H}} - \frac{1}{\eta_{post,H}}\right)$$

Where,

$CAPC$ = Rated equipment cooling capacity of the new unit (BTU/hr.)

$CAPH$ = Rated equipment heating capacity of the new unit (BTU/hr.)

$\eta base$, = Baseline energy efficiency rating of the baseline cooling equipment (EER)

$\eta post$, = Nameplate energy efficiency rating of the installed cooling equipment (EER)

$\eta post$,= Nameplate energy efficiency rating of the installed heating equipment (COP)

Note: heating efficiencies expressed as a heating seasonal performance factor (HSPF) will need to be converted to a coefficient of performance (COP) using the following equation:

$$\text{COP} = \text{HSPF} \div 3.412$$

3,412 = Constant to convert from BTU/hr. to kWh

CF= Coincidence factor (Table 138)

$EFLH_c$ = Equivalent full-load hours for cooling (Table 137)

$EFLH_h$= Equivalent full-load hours for heating (Table 137)

Table 137: Equivalent Full-Load Hours by Building Type

Building Type	$EFLH_C$	$EFLH_H$
Fast Food	2,375	272
Grocery	1,526	153
Health Clinic	1,989	115
Large Office	1,483	392
Lodging	2,095	409
Full Menu Restaurant	1,997	166
Retail	3,191	513
School	2,329	140
Small Office	2,060	255
University	1,510	604

Table 138: Commercial Coincidence Factors by Building Type[265]

Building Type	Coincidence Factor
Fast Food	0.78
Grocery	0.90
Health Clinic	0.85
Large Office	0.84
Lodging	0.77
Full Menu Restaurant	0.85
Retail	0.88
School	0.71
Small Office	0.84
College	0.84

[265] Values for Assembly and Religious Worship building types developed using an adjustment factor derived through a comparison of average CFs for College/University and Assembly/Religious Worship building types from the Texas state Technical Reference Manual. College/University was selected as a reference building type due to average alignment with Assembly/Religious worship building types in other TRMs, inclusion of a summer session, and increased evening usage.

C.3.1.6. Incremental Cost

The incremental cost for this equipment is $84/ton[266]. The average tonnage is assumed to be .92 if unknown, resulting in an incremental cost of $77.

C.3.1.7. Future Studies

Though eligible for Energy Smart, this measure has had little-to-no participation. Until such time as participation produces a minimum of 500,000 kWh in a program year, it is recommended that updates be limited to those needed to reflect code changes.

If this threshold is met, we recommend focusing M&V to update EFLH estimates.

[266] DEER 2014.

C.3.2. Unitary and Split System AC/HP Equipment

C.3.2.1. Measure Description

This measure requires the installation of packaged or split system air conditioners (AC) or heat pumps (HP), excluding PTACs/PTHPs. Unitary or split system ACs/HPs consist of one or more factory-made assemblies that normally include an evaporator or cooling coil(s), compressor(s), and condenser(s). They provide the function of air cooling, and may include the functions of air heating, air circulation, air cleaning, dehumidifying, or humidifying.

C.3.2.2. Baseline and Efficiency Standards

The baseline for units that are used in new construction or are replaced on burnout is the current federal minimum standard,[267] which went into effect January 1, 2010 (Table 139).

As of January 1, 2015, split system heat pumps < 65,000 Btu/h must comply with 10 CFR 430.32(c)(3) for Residential Central Air Conditioners and Heat Pumps. Split systems are not explicitly covered by originally specified federal standard 10 CFR 431.97 for Commercial package air condition and heating equipment. Split system air conditioners are not affected because the existing SEER and HSPF values remain unchanged.

Table 139: Unitary AC/HP Equipment – Baseline Efficiency Levels[268]

Equipment Type	***Capacity (Btu/h)***	***Heating Section Type***	***Sub-Category***	***Minimum Efficiency***
Air Conditioners, Air Cooled	< 65,000	All	Split System & Single Package	11.2 EER[350] 13.0 SEER
	≥ 65,000 & <135,000	Electric Resistance (or none)	Split System & Single Package	11.2 EER 11.4 SEER
	≥ 65,000 & <135,000	All other	Split System & Single Package	11.0 EER 11.2 SEER
	≥ 135,000 &	Electric Resistance	Split System &	11.0 EER

[267] 2010 U.S. Code: Title 42, Chapter 77, Subchapter III, Part A-1, Section 6313.

[268] IECC 2012, Table C403.2.3(1) & C403.2.3(2); full-load efficiencies consistent with ASHRAE Standard 90.1-2007, Table 6.8.1A & 6.8.1B and compliant with the federal standard.

	<240,000	(or none)	Single Package	11.2 SEER
	≥ 135,000 & <240,000	All other	Split System & Single Package	10.8 EER 11.0 SEER
	≥ 240,000 & <760,000	Electric Resistance (or none)	Split System & Single Package	10.0 EER 10.1 SEER
	≥ 240,000 & <760,000	All other	Split System & Single Package	9.8 EER 9.9 SEER
	≥ 760,000	Electric Resistance (or none)	Split System & Single Package	9.7 EER 9.8 SEER
	≥ 760,000	All other	Split System & Single Package	9.5 EER 9.6 SEER
Air Conditioners, Water and Evaporatively Cooled[351]	< 65,000	All	Split System & Single Package	12.1 EER 12.3 IEER
	≥ 65,000 & <135,000	Electric Resistance (or none)	Split System & Single Package	11.5 EER 11.7 IEER
	≥ 65,000 & <135,000	All other	Split System & Single Package	11.3 EER 11.5 IEER
	≥ 135,000 & <240,000	Electric Resistance (or none)	Split System & Single Package	11.0 EER 11.2 IEER
	≥ 135,000 & <240,000	All other	Split System & Single Package	10.8 EER 11.0 IEER
	≥ 240,000	Electric Resistance (or none)	Split System & Single Package	11.0 EER 11.1 IEER
	≥ 240,000	All other	Split System &	10.8 EER

			Single Package	10.9 SEER
Heat Pumps, Air Cooled (Cooling Mode)	< 65,000	All	Single Package	11.2 EER[352] 13.0 SEER
			Single Package (before 1/1/2015)	11.2 EER[353] 13.0 SEER
			Single Package (after 1/1/2015)[354]	11.8 EER[355] 14.0 SEER
	≥65,000 & <135,000	Electric Resistance (or none)	Split System & Single Package	11.0 EER 11.2 IEER
	≥65,000 & <135,000	All other	Split System & Single Package	10.8 EER 11.0 IEER
	≥135,000 & <240,000	Electric Resistance (or none)	Split System & Single Package	10.6 EER 10.7 IEER
	≥135,000 & <240,000	All other	Split System & Single Package	10.4 EER 10.5 IEER
	≥240,000	Electric Resistance (or none)	Split System & Single Package	9.5 EER 9.6 IEER
	≥240,000	All other	Split System & Single Package	9.3 EER 9.4 IEER
Heat Pumps, Air Cooled (Heating Mode)	<65,000	N/A	Single Package	7.7 HSPF
			Single Package (before 1/1/2015)	7.7 HSPF
			Single Package (after 1/1/2015)[356]	8.2 HSPF
	≥65,000 &	N/A	Split System &	3.3 COP

	<135,000		Single Package	
	≥135,000	N/A	Split System & Single Package	3.2 COP

C.3.2.3. Estimated Useful Life (EUL)

According to the DEER 2014, the EUL for this measure is 15 years.

C.3.2.1. Deemed Savings Values

This measure has significant variability in equipment capacity and thus a per-unit savings value is not likely to be usable by program administrators. Due to this we present savings in a per-ton basis, assuming 15 SEER, 12.5 EER, and 9.0 HSPF (where applicable.

Table 140: Deemed Savings by Building Type - AC

Building Type	kWh/Ton	kW/Ton
Fast Food	645	0.2117
Grocery	414	0.2443
Health Clinic	540	0.2307
Large Office	403	0.2280
Lodging	569	0.2090
Full Menu Restaurant	542	0.2307
Retail	866	0.2389
School	632	0.1927
Small Office	559	0.2280
University	410	0.2280
Unknown	558	0.2242

Table 141: Deemed Savings by Building Type – Heat Pump

Building Type	kWh/Ton	kW/Ton
Fast Food	680	0.2117
Grocery	434	0.2443
Health Clinic	555	0.2307
Large Office	454	0.2280
Lodging	622	0.2090
Full Menu Restaurant	564	0.2307
Retail	933	0.2389
School	650	0.1927
Small Office	592	0.2280
University	488	0.2280
Unknown	597	0.2242

C.3.2.2. Calculated Deemed Savings

Deemed peak demand and annual energy savings for unitary AC and HP equipment should be calculated as shown below. Note that these savings calculations are different depending on whether the measure is replace-on-burnout or early retirement.

$$kW_{Savings} = CAP \times \frac{1\ kW}{1{,}000\ W} \times \left(\frac{1}{\eta_{base}} - \frac{1}{\eta_{post}}\right) \times CF$$

$$kWh_{Savings,AC} = CAP \times \frac{1\ kW}{1{,}000\ W} \times EFLH_C \times \left(\frac{1}{\eta_{base}} - \frac{1}{\eta_{post}}\right)$$

$$kWh_{Savings,HP} = CAP \times \frac{1\ kW}{1{,}000\ W} \times \left[\left(\frac{EFLH_C}{\eta_{base,AC}} + \frac{EFLH_H}{\eta_{base,HP}}\right) - \left(\frac{EFLH_C}{\eta_{post,AC}} + \frac{EFLH_H}{\eta_{post,HP}}\right)\right]$$

Where,

CAP = Rated equipment cooling capacity of the new unit (BTU/hr)

$\eta_{base,AC/HP}$ = Baseline energy efficiency rating of the cooling/heating equipment (Table 139)

$\eta_{post,AC/HP}$ = Nameplate energy efficiency rating of the installed cooling/heating equipment

Note: Use EER for kW savings calculations and SEER/IEER and HSPF for kWh savings calculations.

CF = Coincidence factor (Table 143)

$EFLH_c$ = Equivalent full-load hours for cooling (Table 142)

$EFLH_h$ = Equivalent full-load hours for heating (Table 142)

Table 142 Equivalent Full-Load Hours by building type

Building Type	**$EFLH_C$**	**$EFLH_H$**
Fast Food	2,375	272
Grocery	1,526	153
Health Clinic	1,989	115
Large Office	1,483	392
Lodging	2,095	409
Full Menu Restaurant	1,997	166
Retail	3,191	513
School	2,329	140
Small Office	2,060	255
University	1,510	604

Table 143 Commercial Coincidence Factors by Building Type[269]

Building Type	***Coincidence Factor***
Fast Food	0.78
Grocery	0.90
Health Clinic	0.85
Large Office	0.84
Lodging	0.77
Full Menu Restaurant	0.85
Retail	0.88
School	0.71
Small Office	0.84
College	0.84

C.3.2.3. Incremental Cost

Incremental cost is detailed in *Table 144* below.

Table 144 Unitary AC Incremental Cost

Capacity	***Cost Per Ton per 1.0 SEER above 14.0***
65,000 Btuh or less	$82
65,000 to 240,000 Btuh	$48
240,000 to 760,000 Btuh	$180
760,000 Btuh or more	$181

[269] Values for Assembly and Religious Worship building types developed using an adjustment factor derived through a comparison of average CFs for College/University and Assembly/Religious Worship building types from the Texas state Technical Reference Manual. College/University was selected as a reference building type due to average alignment with Assembly/Religious worship building types in other TRMs, inclusion of a summer session, and increased evening usage.

C.3.2.1. Future Studies

Though eligible for Energy Smart, this measure has had little-to-no participation. Until such time as participation produces a minimum of 500,000 kWh in a program year, it is recommended that updates be limited to those needed to reflect code changes.

If this threshold is met, we recommend focusing M&V to update EFLH estimates.

C.3.3. Air- and Water-Cooled Chillers

C.3.3.1. Measure Description

This measure requires the installation of any air cooled or water cooled chilling package, referred to as a chiller. AHRI Test Standard 550/590-2003 defines a water-chilling package as “a factory-made and prefabricated assembly of one or more compressor, condensers, and evaporators, with interconnections and accessories, designed for the purpose of cooling water. It is a machine specifically designed to make use of a vapor compression refrigeration cycle to remove heat from water and reject the heat to a cooling medium, usually air or water.”

The most common applications are for larger cooling loads (e.g., 50 to 100 tons and greater). Chiller types include centrifugal, rotary, screw, scroll, reciprocating, and gas absorption. Absorption chillers are subject to a different AHRI test standard and not reviewed as part of this analysis. When a water-cooled chiller is replacing an air-cooled chiller, the additional auxiliary electrical loads for the condenser water pump and the cooling tower fan have to be considered. Thus a penalty factor is necessary as a downward adjustment to account for the peak demand and energy savings.

To qualify, the chiller must serve an HVAC load. Chillers used as part of industrial processes require custom analysis.

C.3.3.2. Baseline and Efficiency Standards

The baseline for units that are used in new construction or are replaced on burnout is the current state minimum standard,[270] which went into effect January 21, 2013 (Table 145).

[270] ASHRAE Standard 90.1-2007.

Table 145 Chillers – Baseline Efficiency Levels for Chilled Water Packages[271]

Equipment Type	Chiller Type	Capacity (Tons)	Minimum Efficiency
Air cooled	All	< 150	9.562 EER 12.5 IPLV
		≥ 150	9.562 EER 12.75 IPLV
Water cooled	Rotary/ Screw/Scroll/ Reciprocating	< 75	0.780 kW/ton 0.630 IPLV
		≥ 75 and < 150	0.775 kW/ton 0.615 IPLV
		≥ 150 and < 300	0.680 kW/ton 0.580 IPLV
		≥ 300	0.620 kW/ton 0.540 IPLV
Water cooled	Centrifugal	< 300	0.634 kW/ton 0.596 IPLV
		≥ 300 and < 600	0.576 kW/ton 0.549 IPLV
		≥ 600	0.570 kW/ton 0.539 IPLV

C.3.3.3. Estimated Useful Life (EUL)

For high-efficiency chillers, according to the DEER 2014, the estimated useful life (EUL) is 20 years.

C.3.3.1. Deemed Savings Values

This measure has significant variability in equipment capacity and thus a per-unit savings value is not likely to be usable by program administrators. Due to this we present savings in a per-ton basis, assuming 15.81 IPLV and.87 kW/ton at full load[272].

[271] The values in the table reflect IECC 2009, Table 503.2.3(7).

[272] https://energy.gov/eere/femp/purchasing-energy-efficient-air-cooled-electric-chillers

Table 146: Deemed Savings – Air-Cooled Chillers

Building Type	kWh/Ton	kW/Ton
Fast Food	7,880	0.6543
Grocery	5,063	0.7549
Health Clinic	6,600	0.7130
Large Office	4,921	0.7046
Lodging	6,951	0.6459
Full Menu Restaurant	6,626	0.7130
Retail	10,588	0.7381
School	7,728	0.5955
Small Office	6,835	0.7046
University	5,010	0.7046
Unknown	6,820	0.6928

For water-cooled chillers using positive displacement (rotary, screw, scroll, or reciprocating) the deemed savings assumes .54 part-load kW/ton (for kWh savings) and .651 full load kW/ton (for kW savings).[273]

[273] https://energy.gov/eere/femp/purchasing-energy-efficient-water-cooled-electric-chillers

Table 147: Deemed Savings – Water-Cooled Chillers – Positive Displacement[274]

Building Type	kWh/Ton	kW/Ton
Fast Food	2,138	2,138
Grocery	1,373	1,373
Health Clinic	1,790	1,790
Large Office	1,335	1,335
Lodging	1,886	1,886
Full Menu Restaurant	1,797	1,797
Retail	2,872	2,872
School	2,096	2,096
Small Office	1,854	1,854
University	1,359	1,359
Unknown	1,850	1,850

For centrifugal chillers, the deemed savings assumes .52 part-load kW/ton (for kWh savings) and .56 full load kW/ton (for kW savings). [275]

[274] Rotary/Screw/Scroll/Reciprocating

[275] https://energy.gov/eere/femp/purchasing-energy-efficient-water-cooled-electric-chillers

Table 148: Deemed Savings – Water-Cooled Chillers – Centrifugal

Building Type	kWh/Ton	kW/Ton
Fast Food	827	0.5242
Grocery	531	0.6048
Health Clinic	692	0.5712
Large Office	516	0.5645
Lodging	729	0.5174
Full Menu Restaurant	695	0.5712
Retail	1,110	0.5914
School	810	0.4771
Small Office	717	0.5645
University	525	0.5645
Unknown	715	0.5551

C.3.3.2. Calculation of Deemed Savings

Deemed peak demand and annual energy savings for chillers should be calculated using the following formulas:

$$kW_{Savings} = CAP \times (\eta_{base} - \eta_{post}) \times CF$$

$$kWh_{savings} = CAP \times EFLH_C \times (\eta_{base} - \eta_{post})$$

Where:

CAP = Rated equipment cooling capacity of the new unit (Tons)

η_{base} = Baseline energy efficiency rating of the baseline cooling equipment (kW/ton or EER converted to kW/ton)

η_{post}= Nameplate energy efficiency rating of the installed cooling equipment (kW/ton)

Note: use full-load efficiency (in units of kW/ton) for kW savings calculations and IPLV (in units of kW/ton) for kWh savings calculations. Cooling efficiencies expressed as an EER will need to be converted to kW/ton using the following equation:

$$\frac{kW}{Ton} = \frac{12}{EER}$$

CF= Coincidence factor ()

$EFLH_c$= Equivalent full-load hours for cooling (*Table 149*)

$EFLH_h$= Equivalent full-load hours for heating (Table 150)

Table 149: Equivalent Full-Load Hours by Building type

Building Type	***$EFLH_C$***	***$EFLH_H$***
Fast Food	2,375	272
Grocery	1,526	153
Health Clinic	1,989	115
Large Office	1,483	392
Lodging	2,095	409
Full Menu Restaurant	1,997	166
Retail	3,191	513
School	2,329	140
Small Office	2,060	255
University	1,510	604

Table 150 : Commercial Coincidence Factors by Building Type

Building Type	***Coincidence Factor***
Fast Food	0.78
Grocery	0.90
Health Clinic	0.85
Large Office	0.84
Lodging	0.77
Full Menu Restaurant	0.85
Retail	0.88
School	0.71
Small Office	0.84

College	0.84

C.3.3.3. Incremental Cost

Incremental cost is detailed in *Table 151* below.

Table 151: Chiller Incremental Cost

Equipment Type	***Capacity***	***Cost Per Ton***
Air-cooled	All capacities	$127/ton[276]
Water-cooled – reciprocating	All capacities	$22/ton[277]
Water-cooled – rotary & scroll	< 150 tons	$351/ton[278]
	>=150 and < 300 tons	$127/ton
	>= 300 tons	$87/ton

C.3.3.4. Future Studies

This is a low-volume, high-savings measure. ADM recommends that chiller projects be flagged for IPMVP Option C or D analysis when they occur.

[276] 2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05, "Cost Values and Summary Documentation", California Public Utilities Commission, December 16, 2008. Calculated as the simple average of screw and reciprocating air-cooled chiller incremental costs from DEER2008. This assumes that baseline shift from IECC 2012 to IECC 2015 carries the same incremental costs. Values should be verified during evaluation

[277] 2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05, "Cost Values and Summary Documentation"

[278] Incremental costs for water-cooled, positive displacement (rotary screw and scroll) from the W017 Itron California Measure Cost Study, accessed via http://www.energydataweb.com/cpuc/search.aspx. The data is provided in a file named "MCS Results Matrix – Volume I".

C.3.4. Commercial Air Conditioner and Heat Pump Tune-Up

C.3.4.1. Measure Description

This measure applies to central air conditioners and heat pumps. An AC tune-up, in general terms, involves checking, adjusting and resetting the equipment to factory conditions, such that it operates closer to the performance level of a new unit. For this measure, the service technician must complete the following tasks according to industry best practices:

- Inspect and clean condenser, evaporator coils, and blower.
- Inspect refrigerant level and adjust to manufacturer specifications.
- Measure the static pressure across the cooling coil to verify adequate system airflow and adjust to manufacturer specifications.
- Inspect, clean, or change air filters.
- Calibrate thermostat on/off setpoints based on building occupancy.
- Tighten all electrical connections, and measure voltage and current on motors.
- Lubricate all moving parts, including motor and fan bearings.
- Inspect and clean the condensate drain.
- Inspect controls of the system to ensure proper and safe operation. Check the starting cycle of the equipment to assure the system starts, operates, and shuts off properly.
- Provide documentation showing completion of the above checklist to the utility or the utility's representative.

C.3.4.2. Baseline and Efficiency Standards

The baseline is a system with demonstrated imbalances of refrigerant charge.

After the tune-up, the equipment must meet airflow and refrigerant charge requirements. To ensure the greatest savings when conducting tune-up services, the eligibility minimum requirement for airflow is the manufacturer specified design flow rate, or 350 CFM/ton, if unknown. Also, the refrigerant charge must be within +/- 3 degrees of target sub-cooling for units with thermal expansion valves (TXV) and +/- 5 degrees of target super heat for units with fixed orifices or a capillary.

The efficiency standard, or efficiency after the tune-up, is assumed to be the manufacturer specified energy efficiency ratio (EER) of the existing central air conditioner or heat pump. The efficiency improvement resulting from the refrigerant charge adjustment depends on the pre-adjustment refrigerant charge.

C.3.4.3. Estimated Useful Life (EUL)

According to DEER 2014, the estimated useful life (EUL) for refrigerant charge correction is 10 years.

C.3.4.1. Deemed Savings Values

This measure has significant variability in equipment capacity and thus a per-unit savings value is not likely to be usable by program administrators. Due to this we present savings in a per-ton basis. Savings assume a 15% efficiency loss.

Table 152: Deemed Savings by Building Type – Commercial AC Tune-up

Building Type	kWh/Ton	kW/Ton
Fast Food	457	0.1502
Grocery	294	0.1733
Health Clinic	383	0.1636
Large Office	285	0.1617
Lodging	403	0.1482
Full Menu Restaurant	384	0.1636
Retail	614	0.1694
School	448	0.1367
Small Office	397	0.1617
University	291	0.1617
Unknown	396	0.1590

Table 153: Deemed Savings by Building Type – Commercial Heat Pump Tune-up

Building Type	***kWh/Ton***	***kW/Ton***
Fast Food	538	0.1529
Grocery	340	0.1765
Health Clinic	420	0.1667
Large Office	395	0.1647
Lodging	519	0.1510
Full Menu Restaurant	436	0.1667
Retail	761	0.1725
School	494	0.1392
Small Office	471	0.1647
University	456	0.1647
Unknown	483	0.1620

C.3.4.2. Calculation of Deemed Savings

Deemed peak demand and annual energy savings for unitary AC/HP tune-up should be calculated using the following formulas:

$$kW_{savings,C} = CAP_C \times \frac{1\ kW}{1{,}000\ W} \times \left(\frac{1}{EER_{pre}} - \frac{1}{EER_{post}}\right) \times CF$$

$$kWh_{savings,C} = CAP_C \times \frac{1\ kW}{1{,}000\ W} \times EFLH_C \times \left(\frac{1}{EER_{pre}} - \frac{1}{EER_{post}}\right)$$

$$kWh_{savings,H} = CAP_H \times \frac{1\ kW}{1{,}000\ W} \times EFLH_H \times \left(\frac{1}{HSPF_{pre}} - \frac{1}{HSPF_{post}}\right)$$

$$kWh_{savings,AC} = kWh_{savings,C}$$

$$kWh_{savings,HP} = kWh_{savings,C} + kWh_{savings,H}$$

Where,

CAP_c= Rated equipment cooling capacity (BTU/hr.)

CAP_h= Rated equipment heating capacity (BTU/hr.)

EER_{pre}= Adjusted efficiency of the equipment for cooling before tune-up

EER_{post}= Nameplate efficiency of the existing equipment for cooling; if unknown, use default EER value from Table 156 and Table 157

Note: Site measurements may be substituted for EER_{pre} and EER_{post}, providing that the measurements are taken on the same site visit and under similar operating conditions using reliable, industry accepted techniques. If onsite measurements are used to measure savings for measures other than refrigerant charge, then the implementer should use an EUL of three years.

$HSPF_{pre}$ = Efficiency of the equipment for heating before tune-up

$HSPF_{post}$ = Nameplate efficiency of the existing equipment for heating; if unknown, use default HSPF value from Table 158.

CF= Coincidence factor (Table 160)

$EFLH_c$= Equivalent full-load hours for cooling (Table 159)

$EFLH_h$= Equivalent full-load hours for heating (Table 159)

$$EER_{pre} = (1 - EL) \times EER_{post}$$

Where,

EEF_{pre}= Adjusted efficiency of the cooling equipment before tune-up

EER_{post}= Nameplate efficiency of the existing cooling equipment; if unknown, use default EER value from Table 156 and Table 157.

EL = Efficiency Loss (Fixed Orifice: Table 154; TXV: Table 155) determined by averaging reported efficiency losses from multiple studies.[279,280,281,282,283] Interpolation of the efficiency loss values presented is allowed. Extrapolation is not allowed.

[279] Architectural Energy Corporation, managed by New Buildings Institute. "Small HVAC System Design Guide." Prepared for the California Energy Commission. October 2003. Figure 11.

[280] Davis Energy Group. "HVAC Energy Efficiency Maintenance Study," California Measurement Advisory Council (CALMAC). December 29, 2010. Figure 14.

[281] Proctor Engineering Group. "Innovative Peak Load Reduction Program CheckMe! Commercial and Residential AC Tune-Up Project." California Energy Commission. November 6, 2003. Table 6-3.

[282] Proctor Engineering Group. PEG Tune-Up Calculations spreadsheet.

[283] Pennsylvania Technical Reference Manual (TRM). June 2012. Measure 3.3.2, Table 3-96.

Table 154: Efficiency Loss Percentage by Refrigerant Charge Level (Fixed Orifice)

% Charged	EL
≤ 70	0.37
75	0.29
80	0.20
85	0.15
90	0.10
95	0.05
100	0.00
≥ 120	0.03

Table 155: Efficiency Loss Percentage by Refrigerant Charge Level (TXV)

% Charged	EL
≤ 70	0.12
75	0.09
80	0.07
85	0.06
90	0.05
95	0.03
100	0.00
≥ 120	0.04

Table 156: Default Air Conditioner EER per Size Category[284]

Size Category (BTU/hr.)	Default EER[285]
< 65,000	11.8
≥ 65,000 and < 135,000	11.0
≥ 135,000 and < 240,000	10.8
≥ 240,000 and < 760,000	9.8
≥ 760,000	9.5

Table 157: Default Heat Pump EER per Size Category[286]

Size Category (BTU/hr.)	Default EER
< 65,000	11.8
≥ 65,000 and < 135,000	10.8
≥ 135,000 and < 240,000	10.4
≥ 240,000	9.3

$$HSPF_{pre} = (HSPF_{post}) \times (1 - M)^{age} \quad (14)$$

Where,

$HSPF_{post}$= HSPF of pre-tune up equipment when new (use nameplate or default value from Table 158)

[284] Code specified SEER or EER value from 2013 Addenda to ASHRAE 90.1-2010 (efficiency value effective January 1, 2015 for units < 65,000 Btu/hr and prior to January 1, 2010 for units ≥ 65,000 Btu/hr).

[284] Code specified SEER or EER value from ASHRAE 90.1-2010 (efficiency value effective January 1, 2015

[285] SEER values converted to EER using EER = -0.02 x $SEER^2$ + 1.12 x SEER. National Renewable Energy Laboratory (NREL). "Building America House Simulation Protocols." U.S. DOE. Revised October 2010. http://www.nrel.gov/docs/fy11osti/49246.pdf.

[286] Code specified SEER or EER value from 2013 Addenda to ASHRAE 90.1-2010 (efficiency value effective January 1, 2015 for units < 65,000 Btu/hr and prior to January 1, 2010 for units > 65,000 Btu/hr).

M = Maintenance factor[287], use 0.01 if annual maintenance conducted or 0.03 if maintenance is seldom

Age = Age of equipment in years, up to a maximum of 20 years, use a default of 10 years if unknown.

Table 158: Default Heat Pump HSPF per Size Category[288]

Size Category (BTU/hr.)	***Subcategory or Rating Condition***	***Default HSPF[289]***
< 65,000	Split System	8.2
	Single Package	8.0
≥ 65,000 and < 135,000	47°F db/43°F wb Outdoor Air	11.3
	17°F db/15°F wb Outdoor Air	7.7
≥ 135,000	47°F db/43°F wb Outdoor Air	10.9
	17°F db/15°F wb Outdoor Air	7.0

287 "Building America House Simulation Protocols." U.S. DOE. Revised October 2010. Table 32. Page 40. http://www.nrel.gov/docs/fy11osti/49246.pdf.

288 Code specified HSPF or COP value from 2013 Addenda to ASHRAE 90.1-2010 (efficiency value effective January 1, 2015 for units < 65,000 Btu/hr and prior to January 1, 2010 for units > 65,000 Btu/hr).

289 COP values converted to HSPF using COP=HSPF÷3.412

Table 159: Equivalent Full-Load Hours by Building Type

Building Type	$EFLH_C$	$EFLH_H$
Fast Food	2,375	272
Grocery	1,526	153
Health Clinic	1,989	115
Large Office	1,483	392
Lodging	2,095	409
Full Menu Restaurant	1,997	166
Retail	3,191	513
School	2,329	140
Small Office	2,060	255
University	1,510	604

Table 160: Commercial Coincidence Factors by Building Type[290]

Building Type	Coincidence Factor
Fast Food	0.78
Grocery	0.90
Health Clinic	0.85
Large Office	0.84
Lodging	0.77
Full Menu Restaurant	0.85
Retail	0.88
School	0.71
Small Office	0.84
College	0.84

[290] Values for Assembly and Religious Worship building types developed using an adjustment factor derived through a comparison of average CFs for College/University and Assembly/Religious Worship building types from the Texas state Technical Reference Manual. College/University was selected as a reference building type due to average alignment with Assembly/Religious worship building types in other TRMs, inclusion of a summer session, and increased evening usage.

C.3.4.3. Incremental Cost

Program-actual costs should be used. If not available, use $35/ton[291].

C.3.4.4. Future Studies

The incremental cost value is very sensitive to labor costs, and as such a New Orleans-specific cost study should be conducted to revise this value. Further, due to past realization rate issues with residential AC tune-up, if this offering is expanded to the commercial sector ADM strongly recommends a whole-program billing analysis to support savings estimates.

[291] Act on Energy Commercial Technical Reference Manual No. 2010-4

C.3.5. Guest Room Energy Management (GREM) Controls

C.3.5.1. Measure Description

Packaged terminal heat pumps (PTHP) and packaged terminal air conditioners (PTAC) are commonly installed in the hospitality industry to provide heating and cooling of individual guest rooms. Occupancy-based PTHP/PTAC controllers are a combination of a control unit and occupancy sensor that operate in conjunction with each other to provide occupancy-controlled heating and/or cooling. The control unit plugs into a wall socket and the PTHP/PTAC plugs into the control unit. The control unit is operated by an occupancy sensor that is mounted in the room and turns the PTHP/PTAC on and off. The most common application for occupancy-based PTHP/PTAC controls is hotel rooms.

To qualify for savings, equipment must have a setback of at least 5 degrees Fahrenheit. Setbacks greater than 8 degrees Fahrenheit are not recommended due to occupant comfort considerations.

C.3.5.2. Baseline and Efficiency Standards

There is no code requirement for installation of GREM systems. The baseline configuration is a PTAC/PTHP with a manually controlled thermostat.

C.3.5.3. Estimated Useful Life (EUL)

The average lifetime of this measure is eight years, in accordance with DEER 2014.

C.3.5.4. Calculation of Deemed Savings

Estimated gross annual energy savings is 355kWh/unit, based on numbers reported by Xcel Energy and scaled appropriately based on New Orleans weather data. There is no peak demand savings associated with this measure. As these savings estimates are based on a single reference, it is recommended that New Orleans work with early program participants to conduct actual pre- and post-measurement of energy use to verify the accuracy of these values.

C.3.5.5. Calculation of Deemed Savings

Only one reference was found that provided a comprehensive overview of estimated savings for this measure; 509 kWh/yr. energy savings (Xcel Energy 2006).

C.3.5.6. Incremental Cost

The incremental cost is the difference between a GREM system and a manual thermostat, $260[292].

[292] DEER 2014 value for energy management systems

C.3.5.1. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using default values from other programs. If this measure is added to Energy Smart programs, the evaluation should include a metering study to support occupancy estimates.

C.4. Refrigeration

C.4.1. Door Heater Controls for Refrigerators and Freezers

C.4.1.1. Measure Description

This measure refers to the installation of anti-sweat door heater controls on glass doors for reach-in commercial refrigerators and freezers. The added control reduces both heater operation time and cooling load.

This measure only qualifies for retrofit applications. New construction applications are not allowed as this measure is standard practice for new construction and comes integrated on most modern glass-door refrigerators and freezers.

C.4.1.2. Baseline and Efficiency Standards

Qualifying equipment includes any controls that reduce the run time of door and frame heaters for refrigerated cases. The baseline efficiency case is a cooler or freezer door heater that operates 8,760 hours per year without any controls. The high efficiency case is a cooler (medium temperature) or freezer (low temperature) door heater connected to a heater control system. There are no state or federal codes or standards that govern the eligibility of equipment.

C.4.1.3. Estimated Useful Life (EUL)

The estimated useful life (EUL) is 12 years as defined in the DEER database.[293]

C.4.1.4. Calculation of Deemed Savings

C.4.1.4.1. Energy Savings

A door heater controller senses dew point (DP) temperature in the store and modulates power supplied to the heaters accordingly. DP inside a building is primarily dependent on the moisture content of outdoor ambient air. Because the outdoor DP varies between weather zones, weather data from each weather zone must be analyzed to obtain a DP profile.

Indoor dew point (t_{d-in}) is related to outdoor dew point (t_{d-out}) according to the following equation. Indoor dew point was calculated at each location for every hour in the year.[294]

$$t_{d-in} = 0.005379 \times t_{d-out}^2 + 0.171795 \times t_{d-out} + 19.870006$$

[293] California's Database for Energy Efficiency Resources (DEER 2014).

[294] Work Paper PGEREF108: Anti-Sweat Heat (ASH) Controls. Pacific Gas & Electric Company. May 29, 2009.

In the base case, the door heaters are all on and have a duty of 100% irrespective of the indoor DP temperature. For the post-retrofit case, the duty for each hourly reading was calculated by assuming a linear relationship between indoor DP and duty cycle for each bin reading. It is assumed that the door heaters will be all off (duty cycle of 0%) at 42.89°F or lower DP and all on (duty cycle of 100%) at 52.87°F or higher DP for a typical supermarket. Between these values, the door heaters' duty cycle changes proportionally:

$$Door\ Heater\ ON\% = \frac{t_{d-in} - All\ OFF\ Setpt\ (42.89°F)}{All\ ON\ Setpt\ (52.87°F) - All\ OFF\ Setpt\ (42.89°F)}$$

Because the controller only changes the run-time of the heaters, instantaneous door heater power (kW_{ASH}) as a resistive load remains constant per linear foot of door heater at:

$$kW_{ASH} = \frac{kW}{ft} \times L_{DH}$$

Where kW/ft. = 0.0368 for medium temperature and 0.0780 for low temperature applications.

Door heater energy consumption for each hour of the year is a product of power and run-time:

$$kWh_{ASH-Hourly} = kW_{Ash} \times Door\ Heater\ ON\% \times 1\ hour$$

Total annual door heater energy consumption (kWh_{ASH}) is the sum of all hourly reading values:

$$kWh_{ASH} = \sum kWh_{ASH-Hourly}$$

Energy savings were also estimated for reduced refrigeration loads using average system efficiency and assuming that 35% of the anti-sweat heat becomes a load on the refrigeration system.[295] The cooling load contribution from door heaters can be given by:

$$Q_{ASH}(ton) = 0.35 \times kW_{ASH} \times \frac{3{,}412\ \frac{Btu/h}{ton}}{12{,}000\ \frac{Btu/h}{ton}} \times Door\ Heater\ ON\%$$

[295] Southern California Edison (SCE), 1999, *"A Study of Energy Efficient Solutions for Anti-Sweat Heaters."* Prepared for the Refrigeration Technology and Test Center (RTTC). December 14. https://www.sce.com/NR/rdonlyres/B1F7A3B4-719D-4CBB-87EB-E27F7CE7ECE0/0/Anti_Sweat_Heater_Report.pdf.

The compressor power requirements are based on calculated cooling load and energy-efficiency ratios obtained from the manufacturers' data. The compressor analysis is limited to the cooling load imposed by the door heaters, not the total cooling load of the refrigeration system.

The typical efficiency for a medium temperature case is 9 EER (1.33 kW/ton), and the typical efficiency for a low temperature case is 5 EER (2.40 kW/ton).[296]

Energy used by the compressor to remove heat imposed by the door heaters for each hourly reading is determined based on calculated cooling load and EER, as outlined below:

$$kWh_{Refrig-Hourly} = Q_{ASH} \times \frac{kW}{ton} \times 1\ hour$$

Total annual refrigeration energy consumption is the sum of all hourly reading values:

$$kWh_{Refrig} = \sum kWh_{Refrig-Hourly}$$

Total annual energy consumption (direct door heaters and indirect refrigeration) is the sum of all hourly reading values:

$$kWh_{Total} = kWh_{Refrig} + kWh_{ASH}$$

Once the annual energy consumption (direct door heaters and indirect refrigeration) has been determined for the baseline and post-retrofit case, the total energy savings are calculated by the following equation:

$$Annual\ Energy\ Savings = \Delta kWh = kWh_{Total-Baseline} - kWh_{Total-Post\ Retrofit}$$

C.4.1.4.2. Demand Savings

It is important to note that while there might be instantaneous demand savings as a result of the cycling of the door heaters, peak demand savings will only be due to the reduced refrigeration load. Peak demand savings was calculated by the equation shown below:

$$Peak\ Demand\ Savings = \Delta kW = \frac{kWh_{Refrig-Baseline} - kWh_{Refrig-Post\ Retrofit}}{8{,}760\ hr/yr}$$

C.4.1.5. Deemed Savings Values

Annual and peak energy savings due to anti-sweat door heater controls in medium and low temperature refrigerated cases for New Orleans. Deemed savings is calculated

[296] Chapter 15 of the 2010 ASHRAE Handbook for Refrigeration

using a ratio compared to El Dorado, AR (Zone 6) Savings provided in the table are per linear foot of glass door controlled heater.

Table 161: Anti-Sweat Heater Controls – Savings per Linear Foot of Case by Location

Weather Zone	*Med-Temperature*		*Low-Temperature*	
	Annual kWh/ft. Savings	*kW/ft. Savings*	*Annual kWh/ft. Savings*	*kW/ft. Savings*
New Orleans (Zone 3)	248	0.0046	259	0.0060

C.4.1.6. Incremental Cost

The full installed cost should be used for this measure. If not available, use $300 per circuit[297].

C.4.1.7. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure had low participation in Energy Smart programs. As a result, savings are calculated using weather-adjusted default values from other programs. If participation exceeds 500,000 kWh, the evaluation should include a metering study to support runtime estimates.

[297] Efficiency Vermont Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions, February, 19, 2010

C.4.2. Solid Door Refrigerators and Freezers

C.4.2.1. Measure Description

Commercial refrigerators and freezers are commonly found in restaurants and other food service industries. Reach-in, solid-door refrigerators and freezers are significantly more efficient than regular refrigerators and freezers due to better insulation and higher-efficiency components. These efficiency levels relate the volume of the appliance to its daily energy consumption.

C.4.2.2. Baseline and Efficiency Standards

Effective January 1, 2010, EPAct 2005 established new federal minimum efficiency levels for solid-door refrigerators and freezers (see Table 162 below). Also included are the minimum efficiency levels for the ENERGY STAR® specifications.

Table 162: Solid-Door Refrigerators and Freezers – Efficiency Levels

Equipment Type	*Efficiency Level*	*Maximum Daily Energy Consumption[298] (kWh/day)*
Refrigerator	Baseline	0.1V + 2.04
Refrigerator	ENERGY STAR®	0<V<15, 0.089V + 1.411
		15≤V<30, 0.037V + 2.2
		30≤V<50, 0.056V + 1.635
		50≤V, 0.060V + 1.416
Freezer	Baseline	0.4V + 1.38
Freezer	ENERGY STAR®	0<V<15, 0.250V + 1.250
		15≤V<30, 0.037V + 2.2
		30≤V<50, 0.163V
		50≤V, 0.158V + 6.333

The standard refrigerator/freezer efficiency is based on *Table 162* which contains the baseline annual energy consumption, and demand, for solid-door refrigerators and freezers.

[298] V is the volume of the refrigerator or freezer in cubic feet.

Table 163: Solid-Door Refrigerators and Freezers – Baseline Measure Information

Type	*Size Range[299] (Cubic Ft)*	*Annual Energy Consumption (kWh/unit)*	*Demand (kW/unit)*
Refrigerator	0-15	1,292	0.15
	15-30	1,840	0.21
	30-50	2,570	0.29
	≥50	3,300	0.38
Freezer	0-15	2,694	0.31
	15-30	4,884	0.56
	30-50	7,804	0.89
	≥50	10,724	1.22

To qualify for this measure, new solid-door refrigerators and freezers must meet ENERGY STAR® minimum efficiency requirements. Table 164 summarizes the estimated performance information for qualifying units.

Table 164: Solid-Door Refrigerators and Freezers – Qualifying Measure Information

Type	*Size Range[300] (Cubic Ft)*	*Annual Energy Consumption (kWh/unit)*	*Demand (kW/unit)*
Refrigerator	0-15	1,002	0.114
	15-30	1,208	0.138
	30-50	1,619	0.185
	≥50	2,050	0.234
Freezer	0-15	1,825	0.208
	15-30	4,015	0.458
	30-50	5,210	0.595
	≥50	6,348	0.725

[299] Solid-door refrigerators and freezers were evaluated for four different sizes or volumes (V), 15, 30, 50 and 70 cubic feet. The unit will be operated for 365 days per year.

[300] Ibid.

C.4.2.3. Estimated Useful Life (EUL)

According to DEER 2014, the estimated useful life (EUL) is 12 years.

C.4.2.4. Deemed Savings Values

Deemed measure savings for qualifying solid-door refrigerators and freezers are presented in Table 165.

Table 165: Solid-Door Refrigerators and Freezers – Deemed Savings Values

Type	*Size Range[301] (Cubic Ft)*	*Annual Energy Consumption (kWh/unit)*	*Demand (kW/unit)*
Refrigerator	0-15	290	0.03
	15-30	631	0.07
	30-50	951	0.11
	≥50	1,250	0.14
Freezer	0-15	869	0.10
	15-30	869	0.10
	30-50	2,593	0.30
	≥50	4,375	0.50

C.4.2.5. Measure Technology Review

Five primary resources contained data about solid-door refrigerators and freezers. The ENERGY STAR® website and the Consortium for Energy Efficiency (CEE) had the same maximum daily energy consumption levels for commercial food-grade refrigerators and freezers. The NPCC report and Ecotope studies gave savings and cost estimates, but did not include the volume of the appliances. NYSERDA's deemed savings and cost database (Nexant 2005) contained data for both refrigerators and freezers at common sizes.

[301] Solid-door refrigerators and freezers were evaluated for four different sizes or volumes (V), 15, 30, 50 and 70 cubic feet. The unit will be operated for 365 days per year.

Table 166: Solid-Door Refrigerators and Freezers – Review of Measure Information

Available Resource	Notes
PG&E 2005[41]	Energy savings and cost estimates for refrigerators and freezers at common sizes
DEER 2014[65]	Energy savings and cost estimates for refrigerators and freezers at common sizes
KEMA 2010[24]	Energy savings and cost estimates for refrigerators and freezers at common sizes
CEE[64]	Maximum daily energy consumption levels (kWh/day) for CEE-qualified commercial qualified food-grade refrigerators and freezers
ENERGY STAR®[69]	Maximum daily energy consumption levels (kWh/day) for commercial qualified food-grade refrigerators and freezers
NEXANT 2005[31]	Energy savings and cost estimates for refrigerators and freezers at common sizes
PacifiCorp 2009[44]	Unitary savings included in comprehensive potential study

Note: Italic numbers are endnotes not footnotes. (See Section 4.4 Commercial Measure Reference)

C.4.2.6. Incremental Cost

The incremental cost is provided in Table 167[302].

Table 167: Solid-Door Refrigerators and Freezers Incremental Costs

Type	*Incremental Cost*
Refrigerator	$143
	$164
	$164
	$249
Freezer	$142
	$166
	$166
	$407

C.4.2.7. Future Studies

This measure applies known values from ENERGY STAR; ADM does not recommend focused study for this measure. Parameters should be updated to correspond to the most recent ENERGY STAR specification.

302 For the purposes of this characterization, assume and incremental cost adder of 5% on the full unit costs presented in Goldberg et al, State of Wisconsin Public Service Commission of Wisconsin, Focus on Energy Evaluation, Business Programs: Incremental Cost Study, KEMA, October 28, 2009.

C.4.3. Refrigerated Case Night Covers

C.4.3.1. Measure Description

This measure applies to the installation of night covers on otherwise open vertical (multi-deck) and horizontal (coffin-type) low-temperature (L) and medium temperature (M) display cases to decrease cooling load of the case during the night. It is recommended that these film-type covers have small, perforated holes to decrease the build-up of moisture.

Cases may be either: Self Contained (SC) having both evaporator and condenser coils, along with the compressor as part of the unit or Remote Condensing (RC) where the condensing unit and compressor are remotely located. Refrigerated case categories[303] are as follows:

- Vertical Open (VO): Equipment without doors and an air-curtain angle ≥ 0° and < 10°
- Semi-vertical Open (SVO): Equipment without doors and an air-curtain angle ≥ 10° and < 80°
- Horizontal Open (HO): Equipment without doors and an air-curtain angle ≥ 80°

This measure is only eligible for retrofit applications. The measure is standard practice in new construction.

C.4.3.2. Baseline and Efficiency Standards

The baseline standard for this measure is an open low-temperature or medium temperature refrigerated display case (vertical or horizontal) that is not equipped with a night cover.

The efficiency standard for this measure is any suitable material sold as a night cover. The cover must be applied for a period of at least six hours per night.

C.4.3.3. Estimated Useful Life (EUL)

According to the California Database of Energy Efficiency Resources (DEER 2014), strip curtains are assigned an EUL of 4 years.

C.4.3.4. Calculation of Deemed Savings

The following outlines the assumptions and approach used to estimate demand and energy savings due to installation of night covers on open low- and medium-temperature, vertical and horizontal, display cases. Heat transfer components of the

[303] U.S. DOE, Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial Industrial Equipment, Commercial Refrigeration Equipment, Washington DC, p3-15

display case include infiltration (convection), transmission (conduction), and radiation. This deemed savings approach assumes that installing night covers on open display cases will only reduce the infiltration load on the case. Infiltration affects cooling load in the following ways:

- Infiltration accounts for approximately 80% of the total cooling load of open vertical (or multi-deck) display cases.[304]
- Infiltration accounts for approximately 24% of the total cooling load of open horizontal (coffin or tub style) display cases.[305]

Installing night covers for a period of 6 hours per night can reduce the cooling load due to infiltration. This was modeled by the U.S. Department of Energy (DOE) for Vertical and Semi-vertical cases.

Table 168: Vertical & Semi-vertical Refrigerated Case Savings

Case Type[306]	***VO.RC.M***	***VO.RC.L***	***VO.SC.M***	***SVO.RC.M***	***SVO.SC.M***
kWh per day- before Night Curtain	50.52	118.44	38.98	38.48	32.82
kWh per day - with Night Curtain	46.84	111.58	36.99	35.74	31.05
Percent kWh Savings per Day	7%	6%	5%	7%	5%
Annual kWh Savings	1,343	2,504	726	1,000	646
Test Case Length (ft.)	12	12	4	12	4

Table 169: Horizontal Refrigerated Case Savings

[304] ASHRAE 2006. Refrigeration Handbook. Retail Food Store Refrigeration and Equipment. Atlanta, Georgia. pp. 46.1, 46.5, 46.10.

[305] Ibid.

[306] U.S. DOE, Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial Industrial Equipment, Commercial Refrigeration Equipment, Washington DC, pp.5-43- 5-47, 5A-5, 5A-6

Case Type[307]	HO.RC.M	HO.RC.L	HO.SC.M	HO.SC.L
kWh per day- before Night Curtain[308]	15.44	34.23	16.06	35.02
kWh per day - with Night Curtain	14.05	31.15	14.61	31.87
Percent kWh Savings per Day[309]	9%	9%	9%	9%
Annual kWh Savings	507	1,124	528	1,150
Test Case Length (ft.)	12	12	4	4

While the DOE also modeled the energy consumption for horizontal open cases, there was not an efficient case modeled with a night cover. The 9% energy savings as found by Faramarzi & Woodworth-Szleper[6] was used to determine the post kWh per day.

C.4.3.5. Deemed Savings Values

Due to the relatively consistent summer dry-bulb temperature across the New Orleans weather zone, deemed savings values are only provided for the average dry-bulb temperature of 96°F.

Table 170: Refrigerated Case Night Covers – Deemed Savings Values (per Linear Foot)[310]

[307] U.S. DOE, Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial Industrial Equipment, Commercial Refrigeration Equipment, Washington DC, pp. 5-48 - 5-51. The level AD3 was used for the baseline efficiency.

[308] Ibid.

[309] ASHRAE 1999 Effects of Low-E Shields on the Performance and Power Use of a Refrigerated Display Case. Faramarzi & Woodworth-Szleper, p.8

[310] Pacific Gas & Electric (PG&E), 2009, "*Night Covers for Open Vertical and Horizontal Display Cases (Low and Medium Temperature Cases),* May 29,.

Case Description	***Temperature Range (°F)***	***kWh Savings (kWh/ft.)***	***kW Savings (kW/ft.)***
Vertical Open, Remote Condensing Medium Temperature	10 – 35 °F	112	0.00
Vertical Open, Remote Condensing Low Temperature	< 10 °F	209	0.00
Vertical Open, Self-Contained Medium Temperature	10 – 35 °F	182	0.00
Semi-vertical Open, Remote Condensing Medium Temperature	10 – 35 °F	83	0.00
Semi-vertical Open, Self-Contained Medium Temperature	10 – 35 °F	162	0.00
Horizontal Open, Remote Condensing Medium Temperature	10 – 35 °F	42	0.00
Horizontal Open, Remote Condensing Low Temperature	< 10 °F	94	0.00
Horizontal Open, Self-Contained Medium Temperature	10 – 35 °F	132	0.00
Horizontal Open, Self-Contained Low Temperature	< 10 °F	288	0.00

Table 171: Refrigerated Case Night Covers – Deemed Savings Values (per Night Cover)[311]

[311] Pacific Gas & Electric (PG&E), 2009, "*Night Covers for Open Vertical and Horizontal Display Cases (Low and Medium Temperature Cases),* May 29,.

Case Description	*Temperature Range (°F)*	*Length (ft.)*	*kWh Savings (kWh/Cover*	*kW Savings (kW/Cover)*
Vertical Open, Remote Condensing Medium Temperature	10 – 35 °F	12	1,344	0.00
Vertical Open, Remote Condensing Low Temperature	< 10 °F	12	2,508	0.00
Vertical Open, Self-Contained Medium Temperature	10 – 35 °F	4	728	0.00
Semi-vertical Open, Remote Condensing Medium Temperature	10 – 35 °F	12	996	0.00
Semi-vertical Open, Self-Contained Medium Temperature	10 – 35 °F	4	648	0.00
Horizontal Open, Remote Condensing Medium Temperature	10 – 35 °F	12	504	0.00
Horizontal Open, Remote Condensing Low Temperature	< 10 °F	12	1,128	0.00
Horizontal Open, Self-Contained Medium Temperature	10 – 35 °F	4	528	0.00
Horizontal Open, Self-Contained Low Temperature	< 10 °F	4	1,152	0.00

C.4.3.1. Incremental Cost

The full measure cost should be used. When not available, use $42 per linear foot (CA DEER 2014). For projects that lack size information, use:

- Remote Condensing: $504
- Self-contained: $168
- Unknown: $336

C.4.3.1. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure had low participation in Energy Smart programs. As a result, savings are calculated using weather-adjusted default values from other programs. If participation exceeds 500,000 kWh, the evaluation should include a metering study to support coverage time estimates.

C.4.4. Strip Curtains

C.4.4.1. Measure Description

This measure applies to the installation of strip curtains on walk-in coolers and freezers. This reduces the load on the refrigeration system through reduced infiltration of warm ambient air into the walk-in unit.

This measure is only eligible for retrofit applications. The measure is standard practice in new construction.

C.4.4.2. Baseline and Efficiency Standards

The baseline standard for this measure is a walk-in cooler or freezer with no preexisting strip curtains or damaged strip curtains.

C.4.4.3. Estimated Useful Life (EUL)

According to the California Database of Energy Efficiency Resources (DEER 2014), refrigerated case night covers are assigned an EUL of 5 years.

C.4.4.4. Calculation of Deemed Savings

Calculation of savings from strip curtains is based on Tamm's equation[312] and the ASHRAE handbook[313].

The formula or savings from strip curtains is as follows:

$$\frac{kWh\ Savings}{ft.^2} = \frac{365 \times t_{open} \times (Eff_{new} - E_{old}) \times 20 \times CD \times A \times \left\{\left[\frac{(T_i - T_r)}{T_i}\right] \times g \times h\right\}^{0.5} \times [p_i \times h_i - p_r \times h_r]}{3{,}412\frac{BTU}{kWh} \times COP_{adj} \times A}$$

The parameters are defined in the tables below. Infiltration accounts for approximately 80% of the total cooling load of open vertical (or multi-deck) display cases.[314]

Table 172 summarizes assumptions that are universal across facility types. Table 173 through Table 176 summarize assumptions for specific facilities.

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[312] Kalterveluste durch kuhlraumoffnungen. Tamm W,. Kaltetechnik-Klimatisierung 1966;18;142-144

[313] American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE). 2010. ASHRAE Handbook, Refrigeration: 13.4, 13.6

[314] ASHRAE 2006. Refrigeration Handbook. Retail Food Store Refrigeration and Equipment. Atlanta, Georgia. pp. 46.1, 46.5, 46.10.

Table 172: Strip Curtain Universal Input Assumptions

Parameter	***Unit***	***Value***	***Source***
kWh savings / $ft.^2$	kWh savings / $ft.^2$	Calculated	Calculated
kW savings / $ft.^2$	kW savings / $ft.^2$	Calculated	Calculated
20: product of 60 seconds and integration factor of 1/3	Seconds/minute	20	Tamms equation
g, gravitational constant	$ft./seconds^2$	32.174	Physics constant
1073,412	BTU/kWh	3,412	Physics constant

Table 173: Strip Curtain Input Assumptions for Supermarkets

Parameter	***Unit***	***Value***		***Source***
		Coolers	***Freezers***	
Eff-new: efficacy for new strip curtain.	% of infiltration blocked	.88	.88	http://www.calmac.org/publications/ComFac_Evaluation_V1_Final_Report_02-18-2010.pdf
Eff-old: efficacy for preexisting condition	% of infiltration blocked	Old curtain: .58 No curtain: .00 Unknown: .34	Old curtain: .58 No curtain: .00 Unknown: .30	
CD: Discharge Coefficient, an empirically determined scale factor that accounts for difference in infiltration rates predicted by Bernoulli's law and actual observed rates	None	.336	.415	
t-open, minutes walk-in door is open per day	Minutes/day	132	102	
A, doorway area	$ft.^2$	35	35	
H, doorway height	ft.	7	7	
T_i Dry-bulb temp. of infiltrating air	Deg. F	71	67	
T_i Dry-bulb temp. of refrigerated air	Deg. F	37	5	
COP_{adj}, Coefficient of performance of refrigerators and freezers	Unitless ratio	3.07	1.95	

P, Density of infiltration air at 55% relative humidity	lb./ft.^{2}	.074	.074	Psychometric equations based on dry bulb and relative humidity
h, Enthalpy of infiltration air at 55% relative humidity	BTU/ft.^{2}	26.935	24.678	
p_r Density of refrigerated air at 80% relative humidity	lb./ft.^{2}	.079	.085	
h_r Enthalpy of refrigerated air at 80% relative humidity	BTU/ft.^{2}	12.933	2.081	

Table 174: Strip Curtain Input Assumptions for Convenience Stores

Parameter	***Unit***	***Value***		***Source***
		Coolers	***Freezers***	
Eff-new: efficacy for new strip curtain.	% of infiltration blocked	.79	.83	http://www.calmac.org/publications/ComFac_Evaluation_V1_Final_Report_02-18-2010.pdf
Eff-old: efficacy for preexisting condition	% of infiltration blocked	Old curtain: .58 No curtain: .00 Unknown: .34	Old curtain: .58 No curtain: .00 Unknown: .30	
CD: Discharge Coefficient, an empirically determined scale factor that accounts for difference in infiltration rates predicted by Bernoulli's law and actual observed rates	None	.348	.421	
t-open, minutes walk-in door is open per day	Minutes/day	38	9	
A, doorway area	ft.^{2}	21	21	
H, doorway height	ft.	7	7	
T_i Dry-bulb temp. of infiltrating air	Deg. F	68	64	
T_i Dry-bulb temp. of refrigerated air	Deg. F	39	5	
COP_{adj}, Coefficient of performance of refrigerators and freezers	Unitless ratio	3.07	1.95	
P, Density of infiltration air at	lb./ft.^{2}	.074	.074	Psychometric equations

55% relative humidity				based on dry bulb and relative humidity
h, Enthalpy of infiltration air at 55% relative humidity	BTU/ft.^{2}	25.227	23.087	
p_r Density of refrigerated air at 80% relative humidity	lb./ft.^{2}	.079	.085	
h_r Enthalpy of refrigerated air at 80% relative humidity	BTU/ft.^{2}	13.750	2.081	

Table 175: Strip Curtain Input Assumptions for Restaurants

Parameter	***Unit***	***Value***		***Source***
		Coolers	***Freezers***	
Eff-new: efficacy for new strip curtain.	% of infiltration blocked	.80	.81	http://www.calmac.org/publications/ComFac_Evaluation_V1_Final_Report_02-18-2010.pdf
Eff-old: efficacy for preexisting condition	% of infiltration blocked	Old curtain: .58 No curtain: .00 Unknown: .33	Old curtain: .58 No curtain: .00 Unknown: .26	
CD: Discharge Coefficient, an empirically determined scale factor that accounts for difference in infiltration rates predicted by Bernoulli's law and actual observed rates	None	.383	.442	
t-open, minutes walk-in door is open per day	Minutes/day	45	38	
A, doorway area	ft.^{2}	21	21	
H, doorway height	ft.	7	7	
T_i Dry-bulb temp. of infiltrating air	Deg. F	70	67	
T_i Dry-bulb temp. of refrigerated air	Deg. F	39	8	
COP_{adj}, Coefficient of performance of refrigerators and freezers	Unitless ratio	3.07	1.95	
P, Density of infiltration air at 55% relative humidity	lb./ft.^{2}	.074	.074	Psychometric equations based on dry bulb and

h, Enthalpy of infiltration air at 55% relative humidity	BTU/ft.^{2}	26.356	24.678	relative humidity
p_r Density of refrigerated air at 80% relative humidity	lb./ft.^{2}	.079	.085	
h_r Enthalpy of refrigerated air at 80% relative humidity	BTU/ft.^{2}	13.750	2.948	

Table 176: Strip Curtain Input Assumptions for Refrigerated Warehouses

Parameter	***Unit***	***Value***	***Source***
Eff-new: efficacy for new strip curtain.	% of infiltration blocked	.80	http://www.calmac.org/publications/ComFac_Evaluation_V1_Final_Report_02-18-2010.pdf
Eff-old: efficacy for preexisting condition	% of infiltration blocked	Old curtain: .58 No curtain: .00 Unknown: .54	
CD: Discharge Coefficient, an empirically determined scale factor that accounts for difference in infiltration rates predicted by Bernoulli's law and actual observed rates	None	.425	
t-open, minutes walk-in door is open per day	Minutes/day	494	
A, doorway area	ft.^{2}	80	
H, doorway height	ft.	10	
T_i Dry-bulb temp. of infiltrating air	Deg. F	59	
T_i Dry-bulb temp. of refrigerated air	Deg. F	28	
COP_{adj}, Coefficient of performance of refrigerators and freezers	Unitless ratio	1.91	
P, Density of infiltration air at 55% relative humidity	lb./ft.^{2}	.076	Psychometric equations based on dry bulb and

h, Enthalpy of infiltration air at 55% relative humidity	BTU/ft.^{2}	20.609	relative humidity
p_r Density of refrigerated air at 80% relative humidity	lb./ft.^{2}	.081	
h_r Enthalpy of refrigerated air at 80% relative humidity	BTU/ft.^{2}	9.462	

C.4.4.5. Deemed Savings Values

Table 177 summarizes savings by system, baseline, and facility type for strip curtains on a per-square-foot basis.

Table 177: Strip Curtains – Deemed Savings Values (per Square Foot)[315]

[315] Pacific Gas & Electric (PG&E), 2009, "*Night Covers for Open Vertical and Horizontal Display Cases (Low and Medium Temperature Cases),* May 29,.

Case Description	***Preexisting Curtains***	***kWh Savings (kWh/ft.^{2})***	***kW Savings (kWh/ft.^{2})***
Supermarket – Cooler	Yes	62	0.00708
Supermarket – Cooler	No	108	0.01233
Supermarket – Cooler	Unknown	37	0.00422
Supermarket – Freezer	Yes	179	0.02043
Supermarket – Freezer	No	349	0.03984
Supermarket – Freezer	Unknown	61	0.00696
Convenience Store - Cooler	Yes	5	0.00057
Convenience Store - Cooler	No	20	0.00228
Convenience Store - Cooler	Unknown	11	0.00126
Convenience Store - Freezer	Yes	8	0.00091
Convenience Store - Freezer	No	27	0.00308
Convenience Store - Freezer	Unknown	17	0.00194
Restaurant - Cooler	Yes	8	0.00091
Restaurant – Cooler	No	30	0.00342
Restaurant – Cooler	Unknown	18	0.00205
Restaurant - Freezer	Yes	34	0.00388
Restaurant - Freezer	No	119	0.01358
Restaurant - Freezer	Unknown	81	0.00925
Refrigerated Warehouse	Yes	254	0.02900
Refrigerated Warehouse	No	729	0.08322
Refrigerated Warehouse	Unknown	287	0.03276

Table 178 summarizes the deemed savings that should be used when project-specific data is not available. These values are per-walk-in door and assume the following:

- Doorway area:
    - Supermarket: 35
    - Convenience Store: 21
    - Restaurant: 21
    - Refrigerated Warehouse: 80
- Preexisting curtains: Unknown

Table 178: Strip Curtains – Deemed Savings Values (per Square Foot)[316]

Case Description	Preexisting Curtains	kWh Savings (kWh/door)	kW Savings (kW/door)
Supermarket – Cooler	Unknown	1,295	0.1477
Supermarket – Freezer	Unknown	2,135	0.2436
Convenience Store - Cooler	Unknown	231	0.02646
Convenience Store - Freezer	Unknown	357	0.04074
Restaurant – Cooler	Unknown	378	0.04305
Restaurant - Freezer	Unknown	1,701	0.19425
Refrigerated Warehouse	Unknown	22,960	2.6208

C.4.4.6. Incremental Cost

The full measure cost should be used. When not available, use $10.22 per linear foot (CA DEER 2014).

For projects that lack specific inputs for size, the default incremental costs are:

- Supermarket: $358
- Convenience Store: $215
- Restaurant: $215
- Refrigerated Warehouse: $818

C.4.4.7. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure had low participation in Energy Smart programs. As a result, savings are calculated using weather-adjusted default values from other programs. If participation exceeds 500,000 kWh, the evaluation should include a metering study to support coverage time estimates.

[316] Pacific Gas & Electric (PG&E), 2009, "*Night Covers for Open Vertical and Horizontal Display Cases (Low and Medium Temperature Cases),* May 29,.

C.4.5. Zero Energy Doors

C.4.5.1. Measure Description

This measure applies to the installation of zero energy doors for refrigerated cases. Zero energy doors eliminate the need for anti-sweat heaters to prevent the formation of condensation on the glass surface by incorporating heat reflective coatings on the glass, gas inserted between the panes, non-metallic spacers to separate glass panes, and/or non-metallic frames.

This measure cannot be used in conjunction with anti-sweat heat (ASH) controls.

C.4.5.2. Baseline and Efficiency Standards

The baseline standard for this measure is a standard vertical reach-in refrigerated cooler or freezer with anti-sweat heaters on the glass surface of the doors.

The efficiency standard for this measure is a reach-in refrigerated cooler or freezer with special doors installed to eliminate the need for anti-sweat heaters. Doors must have either heat reflective treated glass, be gas-filled, or both.

C.4.5.3. Estimated Useful Life (EUL)

According to the California Database of Energy Efficiency Resources (DEER 2014), zero energy doors are assigned an EUL of 12 years.

C.4.5.4. Calculation of Deemed Savings

$$kW_{savings} = kW_{door} \times BF$$

$$kWh_{savings} = kW_{savings} \times 8760$$

Where:

kW_{door} = Connected load kW of a typical reach-in cooler or freezer door with a heater

BF = Bonus factor for reducing cooling load from eliminating heat generated by the door heater from entering the cooler or freezer

8760 = Annual operating hours

Table 179: Assumptions for Savings Calculations

Variable	Deemed Values
kW_{door}[317]	Cooler: 0.075 Freezer: 0.200
BF[318]	Low-Temp Freezer: 1.3 Medium-Temp Cooler: 1.2 High-Temp Cooler: 1.1

C.4.5.5. Deemed Savings Values

Table 180: Zero Energy Doors – Deemed Savings Values (per door)[319]

Measure	kWh Savings	kW Savings	Measure
Low-Temperature Freezer (< 25°F)	2,278	0.26	Low-Temperature Freezer (< 25°F)
Medium-Temperature Cooler (25° - 40°F)	2,102	0.24	Medium-Temperature Cooler (25° - 40°F)
High-Temperature Cooler (41° - 65°F)	723	0.08	High-Temperature Cooler (41° - 65°F)

C.4.5.6. Incremental Cost

The incremental cost is $290 per door.[320]

C.4.5.1. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. If this measure is added to Energy Smart, ADM recommends a baseline study to capture the market share of ASH-controlled doors versus uncontrolled doors.

[317] Based on range of wattages from two manufacturers and metered data (cooler 50-130W, freezer 200-320W). Efficiency Vermont Commercial Master Technical Reference Manual No. 2005-37.

[318] Bonus factor (1+0.65/COP) assumes 2.0 COP for low temp, 3.5 COP for medium temp, and 5.4 COP for high temp, based on the average of standard reciprocating and discuss compressor efficiencies with Saturated Suction Temperatures of -20ºF, 20ºF, and 45ºF, respectively, and a condensing temperature of 90ºF, and manufacturers assumption that 65% of heat generated by door enters the refrigerated case. Efficiency Vermont Commercial Master Technical Reference Manual No. 2005-37.

[319] Temperature ranges based on Commercial Refrigeration Rebate Form, p, 3. Efficiency Vermont. https://www.efficiencyvermont.com/Media/Default/docs/rebates/forms/efficiency-vermont-commercial-refrigeration-rebate-form.pdf.

[320] Vermont TRM

C.4.6. Evaporator Fan Controls

C.4.6.1. Measure Description

This measure applies to the installation of evaporator fan controls. As walk-in cooler and freezer evaporators often run continuously, this measure consists of a control system that turns the fan on only when the unit's thermostat is calling for the compressor to operate.

C.4.6.2. Baseline and Efficiency Standards

The baseline standard for this measure is an existing shaded pole evaporator fan motor with no temperature controls with 8,760 annual operating hours.

The efficiency standard for this measure is an energy management system (EMS) or other electronic controls to modulate evaporator fan operation based on temperature of the refrigerated space.

C.4.6.3. Estimated Useful Life (EUL)

According to the California Database of Energy Efficiency Resources (DEER 2014), evaporator fan controls are assigned an EUL of 16 years.[321]

C.4.6.4. Deemed Savings Values

Table 181: Evaporator Fan Controls Deemed Savings Values

Measure	***kWh Savings***	***kW Savings***
Low-Temperature Freezer (< 25°F)	543	0.062
Medium-Temperature Cooler (25° - 40°F)	501	0.057
High-Temperature Cooler (41° - 65°F)	463	0.053

C.4.6.5. Calculation of Deemed Savings

The energy savings from the installation of evaporator fan controls are a result of savings due to the reduction in operation of the fan. The energy and demand savings are calculated using the following equations:

$$kW_{savings} = \left[\left(kW_{evap} \times n_{fans}\right) - kW_{circ}\right] \times \left(1 - DC_{comp}\right) \times DC_{evap} \times BF$$

$$kWh_{savings} = kW_{savings} \times 8760$$

Where:

[321] Database for Energy Efficient Resources (2014). http://www.deeresources.com/.

kW_{evap} = Nameplate connected load kW of each evaporator fan = 0.123 kW (default) [322]

kW_{circ} = Nameplate connected load kW of the circulating fan = 0.035 kW (default) [323]

n_{fans} = Number of evaporator fans

DC_{comp} = Duty cycle of the compressor = 50% (default) [324]

DC_{evap} = Duty cycle of the evaporator fan = Coolers: 100%; Freezers: 94% (default) [325]

BF = Bonus factor for reducing cooling load from replacing the evaporator fan with a lower wattage circulating fan when the compressor is not running = Low Temp.: 1.5, Medium Temp.: 1.3, High Temp.: 1.2 (default) [326]

8760 = Annual hours per year

C.4.6.6. Incremental Cost

The incremental cost is $291 per unit[327].

C.4.6.1. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure had low participation in Energy Smart programs. As a result, savings are calculated using weather-adjusted default values from other programs. If participation exceeds 500,000 kWh, the evaluation should include a metering study to support energy savings estimates.

322 Based on a weighted average of 80% shaded pole motors at 132 watts and 20% PSC motors at 88 watts.

323 Wattage of fan used by Freeaire and Cooltrol.

324 A 50% duty cycle is assumed based on examination of duty cycle assumptions from Richard Traverse (35%-65%), Control (35%-65%), Natural Cool (70%), Pacific Gas & Electric (58%). Also, manufacturers typically size equipment with a built-in 67% duty factor and contractors typically add another 25% safety factor, which results in a 50% overall duty factor.

325 An evaporator fan in a cooler runs all the time, but a freezer only runs 8273 hours per year due to defrost cycles (4 20-min defrost cycles per day).

326 Bonus factor (1+1/COP) assumes 2.0 COP for low temp, 3.5 COP for medium temp, and 5.4 COP for high temp, based on the average of standard reciprocating and discus compressor efficiencies with Saturated Suction Temperatures of -20°F, 20°F, and 45°F, respectively, and a condensing temperature of 90°F.

327 CA DEER 2014

C.4.7. Beverage and Snack Machine Controls

C.4.7.1. Measure Description

This measure involves the installation of a beverage or snack machine control on an existing refrigerated beverage vending machine, refrigerated glass-front reach-in cooler, or non-refrigerated snack machine with a lighted display and no existing controls. Applicable control types include occupancy or schedule-based controls installed on the unit that will reduce energy consumption by powering down the refrigeration and lighting systems when the control does not detect human activity and by reducing the refrigeration process, while still maintaining product quality.

C.4.7.2. Baseline and Efficiency Standards

The baseline for this measure is an existing 120-volt single phase refrigerated or non-refrigerated beverage vending machine, refrigerated reach-in cooler, or non-refrigerated snack machine with a lighted display and no existing controls. Current federal regulations specify that refrigerated bottled or canned beverage vending machines manufactured on or after August 31, 2012 must meet increased energy conservation standards.[328,329] Therefore, any vending machine occupancy controls installed on refrigerated beverage vending machines must be installed on machines that were manufactured and purchased before August 31, 2012 to be eligible for this measure.

C.4.7.3. Estimated Useful Life (EUL)

The estimated useful life (EUL) for this measure for occupancy-based vending controls is five years.[330] The EUL for schedule-based controls is ten years.[331]

C.4.7.4. Calculation of Deemed Savings

C.4.7.4.1. Energy Savings

The following energy savings estimates align conservatively with various other vending miser energy savings studies.[332,333,334] Additionally, in comparing to savings calculation

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[328] U.S. DOE. Refrigerated Beverage Vending Machines: Standards and Test Procedures. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/24.

[329] Refrigerated bottled or canned beverage vending machines manufactured on or after August 31, 2012 must meet the energy conservation standards specified in the Code of Federal Regulations, 10 CFR 421.296. http://www.gpo.gov/fdsys/pkg/CFR-2012-title10-vol3/pdf/CFR-2012-title10-vol3-sec431-292.pdf

[330] Database for Energy Efficiency Resources (DEER) 2014. Used value specified for Vending Machine Controllers.

[331] Energy & Resource Solutions (ERS), "Measure Life Study". Prepared for the Massachusetts Joint Utilities. November 17, 2005. Used median value specified for Novelty Cooler Shutoff.

[332] Deru, M., et. al. 2003, "*Analysis of NREL Cold-Drink Vending Machines for Energy Savings*". June. National Renewable Energy Laboratory (NREL). http://www.nrel.gov/docs/fy03osti/34008.pdf

methodologies for schedule-based controls from other TRMs, the energy savings factors defined in this measure produce energy savings that are more in line with expected savings percentages. This is likely due to the exclusion of a morning start-up penalty, used to represent the additional energy required to return to typical operating temperatures, from some TRMs.[335]

$$kWh_{Savings} = W_{CL} \times \frac{1\ kW}{1000\ W} \times AOH \times ESF$$

Where:

W_{CL} = Connected load of controlled beverage or snack machine; if unknown, use default values from Table 182.

AOH = Annual Operating Hours = 8,760 hours for occupancy-based controls; for schedule-based controls, assume one less hour than the number of hours that the installation location is closed per day

ESF = *Energy Savings Factor from Table 183*

Table 182: Default Connected Load by Machine Type

Machine Type	***Connected Load (W)***
Refrigerated beverage vending machine	400
Refrigerated glass-front reach-in cooler	460
Non-refrigerated snack vending machine	85

Table 183: Energy Savings Factor by Machine Type[336]

Machine Type	***ESF***
Refrigerated beverage vending machine	46%
Refrigerated glass-front reach-in cooler	30%
Non-refrigerated snack vending machine	46%

[333] Foster-Miller, Inc., "Vending Machine Energy Efficiency Device Engineering Evaluation and Test Report". June 1, 2000. Bayview Technology Group, Inc. http://www.energymisers.com/downloads/FosterMillerReportVMEnergyNoCover.pdf

[334] Ritter, J & Hugghins, J. 2000 Joel Hugghins, "Vending Machine Energy Consumption and Vending Miser Evaluation". October 31. Texas A&M Energy Systems Laboratory. http://repository.tamu.edu/bitstream/handle/1969.1/2006/ESL-TR-00-11-01.pdf

[335] Select Energy Services, Inc., "Analysis of Cooler Control Energy Conservation Measures: Final Report. March 3, 2004. Submitted to NSTAR Electric.

[336] Product data sheets from USA Technologies, Inc. http://www.energymisers.com.

C.4.7.4.2. Demand Savings

Metered data from a Sacramento Municipal Utility District (SMUD) program evaluation found an average demand impact of 0.030 kW/unit using a peak definition of 2 PM to 6 PM.[337] This impact equates to a 7.5% demand reduction, using the USA Technologies, Inc. controlled load estimate of 400 W for refrigerated beverage vending machines. Assuming a comparable load reduction for other equipment types, this measure estimates an average demand impact of 0.035 kW/unit for refrigerated reach-in coolers and 0.006 kW/unit for non-refrigerated snack vending machines.

No demand savings are claimed for schedule-based beverage and snack machine controls because energy savings typically occur during off-peak hours.

$$kW_{Savings} = W_{CL} \times \frac{1\ kW}{1000\ W} \times DSF$$

Where:

W_{CL} = Connected load of controlled beverage or snack machine; if unknown, use default values from Table 182.

DSF = Demand Savings Factor = 7.5% (occupancy controls); 0% (schedule controls)

C.4.7.5. Deemed Savings Values

Table 184: Occupancy-based Controls – Energy and Demand Savings by Machine Type

Machine Type	Annual Energy Savings (kWh/unit)	Peak Demand Savings (kW/unit)
Refrigerated beverage vending machine	1,612	0.030
Refrigerated glass-front reach-in cooler	1,209	0.035
Non-refrigerated snack vending machine	343	0.006

[337] Chappell, C., et. al. 2002 "Does It Keep The Drinks Cold and Reduce Peak Demand?: An Evaluation of a Vending Machine Control Program". Heschong Mahone Group, Sacramento Municipal Utility District (SMUD), RLW Analytics, Inc., and American Council for an Energy-Efficient Economy (ACEEE). http://aceee.org/proceedings-paper/ss02/panel10/paper05

Table 185: Schedule-based Controls – Energy and Demand Savings by Machine Type

Machine Type	Annual Energy Savings (kWh/unit)	Peak Demand Savings (kW/unit)
Refrigerated beverage vending machine	Use energy savings algorithms with site-specific annual operating hours	0
Refrigerated glass-front reach-in cooler		0
Non-refrigerated snack vending machine		0

C.4.7.6. Incremental Cost

Full measure cost should be used. If not available, use $180 for refrigerated machines and $80 for non-refrigerated machines[338].

C.4.7.7. Future Studies

This measure has received significant metering in support of its California DEER savings estimate, and ADM has concluded that metering for New Orleans units would not add value to the precision of these savings estimates. Savings should be updated to correspond to CA DEER.

[338] Illinois TRM, based on ComEd workpapers

C.4.8. Commercial Ice Makers

C.4.8.1. Measure Description

This measure applies to ENERGY STAR® air-cooled commercial ice makers in retrofit and new construction applications. Commercial ice makers are classified as either of two equipment types: batch type (also known as cube-type) and continuous type (also known as nugget or flakers). Both of these equipment types are eligible for ENERGY STAR® certification based on their configuration as ice-making heads (IMHs), remote condensing units (RCUs) and self-contained units (SCUs). Also eligible are remote condensing units designed for connection to a remote condenser rack.

The industry standard for energy and potable water use and performance of commercial ice makers is the Department of Energy (DOE) Standard 10 CFR Part 431 Subpart H[339] and AHRI Standard 810. Key parameters reported for ice makers include the Equipment Type, Harvest Rate (lbs. of ice/24hrs) and Energy Consumption Rate (kWh/100lbs of ice). The AHRI Directory of Certified Equipment[340] lists these values by equipment manufacturer and model number.

C.4.8.2. Baseline and Efficiency Standards

The ENERGY STAR®[341] criteria for ice makers define efficiency requirements for both energy and potable water use. The baseline standard for batch ice makers are current federal minimum levels that went into effect January 1, 2010. DOE recently published “trial” baseline levels for continuous ice makers.[342] Baseline and efficiency standards should be reviewed on an annual basis to reflect the latest requirements.

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339 10 CFR Part 431 Subpart H, Automatic Commercial Ice Makers. 77 FR 1591. January 11, 2012.

340 http://www.ahridirectory.org/ahridirectory/pages/acim/defaultSearch.aspx

341 ENERGY STAR® Commercial Ice Makers Version 2.0, effective on February 1, 2013.

342 U.S. DOE Report on Automatic Commercial Ice Machines (ACIM) on baseline values, http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/acim_preliminary_tsd_ch5_engineering_2012_01_16.pdf

Table 186: Federal Minimum Standards for Air-Cooled Batch Ice Makers (H=Harvest Rate)

Equipment Type	***Ice Harvest Rate (H) Range (lbs. of ice/24 hrs.)***	***Batch Ice Makers Energy Consumption Rate (kWh/100 lbs. ice)***
Ice Making Heads	<450	10.26 - 0.0086H
	≥450	6.89 - 0.0011H
Remote Condensing Units (w/out remote compressor)	<1,000	8.85 - 0.0038H
	≥1,000	5.1
Remote Condensing Units (w/ remote compressor)	<934	8.85 - 0.0038H
	≥934	5.3
Self-Contained Units	<175	18.0 - 0.0469H
	≥175	9.8

Table 187: DOE Trial Baseline Efficiency Levels for Air-Cooled Continuous Ice Makers

Equipment Type	***Ice Harvest Rate (H) Range (lbs. of ice/24 hrs.)***	***Batch Ice Makers Energy Consumption Rate (kWh/100 lbs. ice)***
Ice Making Heads	<450	10.3 - 0.004H
	≥450	6.3
Remote Condensing Units (w/out remote compressor)	<1,000	9.5 - 0.004H
	≥1,000	5.5
Self-Contained Units	<175	18.0 - 0.0469H
	≥175	9.8

Table 188: ENERGY STAR® Requirements for Air-Cooled Batch Ice Makers (H = Harvest Rate)

Equipment Type	***Ice Harvest Rate (H) Range (lbs. of ice/24 hrs.)***	***Batch Ice Makers Energy Consumption Rate (kWh/100 lbs. ice)***	***Portable Water Use (gal/100 lbs. ice)***
Ice Making Heads	<200 ≤ H ≤1600	$\leq 37.72 * H^{-0.298}$	≤20
Remote Condensing Units	<200 ≤ H ≤1600	$\leq 22.95 * H^{-0.258} + 1.00$	≤20
	<1600 ≤ H ≤4000	≤ -0.00011 * H + 4.60	
Self-Contained Units	<50 ≤ H ≤450	$\leq 48.66 * H^{-0.326 + 0.08}$	≤25

Table 189: ENERGY STAR® Requirements for Air-Cooled Continuous Ice Makers

Equipment Type	***Continuous Ice Makers Energy Consumption Rate (kWh/100 lbs. ice)***	***Portable Water Use (gal/100 lbs. ice)***
Ice Making Heads	$\leq 9.18 * H^{-0.057}$	≤15
Remote Condensing Units	$\leq 6.00 * H^{-0.162} + 3.50$	≤15
Self-Contained Units	$\leq 59.45 * H^{-0.349} + 0.08$	≤15

C.4.8.3. Estimated Useful Life (EUL)

DEER 2011 database shows an estimated useful life (EUL) of 10 years for commercial ice makers.

C.4.8.4. Calculation of Deemed Savings

Annual electric savings can be calculated by determining the energy consumed for baseline ice makers compared against the energy consumed by the qualifying ENERGY STAR®[343] product using the harvest rate of the more efficient unit.

Peak demand savings can then be derived from the electric savings.

[343] As of July 19,2013 the ENERGY STAR® calculator has not been updated to reflect new efficiency levels adopted in February 1, 2013. Deemed savings should be calculated as described here.

$$\Delta kWh = \frac{kWh\,base,per100lb - kWhee,per100lb}{100} \times DC \times H \times 365$$

$$\Delta kW = \left(\frac{\Delta kWh}{HRS}\right) \times CF$$

Where:

ΔkWh = Annual energy savings

kWhbase,per100lb = Calculated based on the harvest rate and type of ice machine from the Federal Minimum Energy Consumption Rate relationships in Table 186: Federal Minimum Standards for Air-Cooled Batch Ice Makers

kWhee,per100lb = Qualifying energy efficient model consumption found in the AHRI directory of certified products by model information.; use the equations in AHRI Table 3 and Table 4 to qualify products be deriving the maximum efficiency performance level[344]

100 = conversion factor to convert kWhbase,per100lb and kWhee,per100lb into maximum kWh consumption per pound of ice

DC = Duty Cycle of the ice maker representing the percentage of time the ice machine is making ice = 0.50[345]

H = Harvest Rate[346] (lbs. of ice made per day)

365 = days per year

HRS = Annual operating hours = 365 × 24 = 8760 hours/year

CF = 1.0[347]

[344] AHRI Directory of Certified Automatic Commercial Ice Cube Machines (ACIM) can be found at http://www.ahridirectory.org/ahridirectory/pages/home.aspx.

[345] TRM assumptions from Vermont, Pennsylvania and Ohio use 40%, Wisconsin uses 50% and Ameren Missouri uses 75% (similar to ENERGY STAR® Commercial Kitchen Equipment Savings Calculator). A field study in California indicated an average duty cycle of 57% ("A Field Study to Characterize Water and Energy Use of Commercial Ice-Cube Machines and Quantify Saving Potential", Food Service Technology Center, December 2007). Conservative approach is to use 40%.

[346] Harvest Rate for all Ice Machines tested in accordance to AHRI 810-2007can be found at http://www.ahridirectory.org/ahridirectory/pages/home.aspx

[347] A New England study, *"Coincidence Factor Study for Residential and Commercial Industrial Lighting Measures", RLW Analytics,* Spring 2007 shows a CF of 0.775 for restaurants; California uses 0.9, Ameren Missouri and Wisconsin uses 1.0. Due to the applicability of this measure in other building types, 1.0 will be used.

C.4.8.5. Example Savings Calculations

Savings calculations for varying Harvest Rates (H) can be seen below based on the ice maker equipment type. The examples below are assuming the energy efficient commercial ice maker as having an energy usage at the ENERGY STAR® level. Actual energy usage can be found on the AHRI directory of certified products.

Table 190: Savings Calculations for Energy Efficient Commercial Ice Makers

Performance	Batch Type			Continuous Type		
	SCU	IMH	RCU	SCU	IMH	RCU
Ice Harvest Rate (lbs. per day)	150	200	750	150	200	750
Baseline Energy Usage (kWh/100lbs)	10.97	8.54	6	10.97	9.5	6.5
ENERGY STAR® Qualifying Energy Usage (kWh/100lbs)	9.58	7.78	5.16	10.42	6.79	5.55
Baseline Daily Consumption (kWh)	6.58	6.83	18	6.58	7.6	19.5
EE Daily Consumption (kWh)	5.75	6.22	15.48	6.25	5.43	16.66
Baseline Annual Consumption (kWh/yr.)	2,401	2,494	6,570	2,401	2,774	7,118
EE Annual Consumption (kWh/yr.)	2,098	2,271	5,649	2,283	1,982	6,081
Baseline Demand (kW)	0.27	0.28	0.75	0.27	0.32	0.81
EE Demand (kW)	0.24	0.26	0.64	0.26	0.23	0.69
Annual Energy Savings (kWh/yr.)	303	223	921	118	792	1,037
Estimated Demand Savings (kW)	0.03	0.03	0.11	0.01	0.09	0.12

C.4.8.6. Incremental Cost

Incremental costs are presented in Table 191[348]

Table 191: Commercial Icemaker Incremental costs

Harvest Rate	***Incremental Cost***
100-200 lbs.	$296
201-300 lbs.	$312
301-400 lbs.	$559
401-500 lbs.	$981
501-1,000 lbs.	$1,485
1,001-1,500 lbs.	$1,821
>1,500 lbs.	$2,194

C.4.8.1. Future Studies

This measure applies known values from ENERGY STAR; ADM does not recommend focused study for this measure. Parameters should be updated to correspond to the most recent ENERGY STAR specification.

[348] These values are from electronic work papers prepared in support of San Diego Gas & Electric's "Application for Approval of Electric and Gas Energy Efficiency Programs and Budgets for Years 2009-2011", SDGE, March 2, 2009. Accessed on 7/7/10 <http://www.sdge.com/regulatory/documents/ee2009-2011Workpapers/SW-ComB/Food%20Service/Food%20Service%20Electic%20Measure%20Workpapers%2011-08-05.DOC>.

C.5. Food Service

C.5.1. Commercial Griddles

C.5.1.1. Measure Description

This measure applies to ENERGY STAR® or its equivalent natural gas and electric commercial griddles in retrofit and new construction applications. This appliance is designed for cooking food in oil or its own juices by direct contact with either a flat, smooth, hot surface or a hot channeled cooking surface where plate temperature is thermostatically controlled.

Energy-efficient commercial electric griddles reduce energy consumption primarily through application of advanced controls and improved temperature uniformity. Energy efficient commercial gas griddles reduce energy consumption primarily through advanced burner design and controls.

C.5.1.2. Baseline and Efficiency Standards

Key parameters for defining griddle efficiency are Heavy Load Cooking Energy Efficiency and Idle Energy Rate. There are currently no federal minimum standards for Commercial Griddles, however, the American Society of Testing and Materials (ASTM) publishes Test Methods[349] that allow uniform procedures to be applied to each commercial cooking appliance for a fair comparison of performance results.

ENERGY STAR® efficiency requirements apply to single and double-sided griddles. The ENERGY STAR® criteria should be reviewed on an annual basis to reflect the latest requirements.

Table 192: ENERGY STAR® Criteria[350] for Electric and Gas Single and Double Sided Griddles

Performance Parameters	***Electric Griddles***
Heavy-Load Cooking Energy Efficiency	≥70%
Idle Energy Rate	≤320 watts per ft^2

349 The industry standard for energy use and cooking performance of griddles are ASTM F1275-03: Standard Test Method for the Performance of Griddles and ASTM F1605-01: Standard Test Method for the Performance of Double-Sided Griddles

350 ENERGY STAR® Commercial Griddles Program Requirements Version 1.1, effective May 2009 for gas griddles and effective January 1, 2011 for electric.

C.5.1.3. Estimated Useful Life (EUL)

According to DEER 2014, commercial griddles are assigned an estimated useful life (EUL) of 12 years.[351]

C.5.1.4. Calculation of Deemed Savings

Annual savings can be calculated by determining the energy consumed by a standard efficiency griddle as compared with an ENERGY STAR® rated griddle.

For electric savings,

$$\Delta kWh = kWhbase - kWheff$$

$$kWh(base\ or\ eff) = kWhcooking + kWhidle + kWhpreheat$$

$$kWhcooking = \left(LBfood \times \frac{Efood}{CookEff}\right) \times Days$$

$$kWhidle = IdleEnergy \times (DailyHrs - \frac{LBfood}{Capacity} - \frac{PreheatTime}{60}) \times Days$$

$$kWhpreheat = PreheatEnergy \times Days$$

Key parameters used to compute savings are defined in Table 193.

Table 193: Energy Consumption Related Parameters for Commercial Griddles[352]

[351] Database for Energy Efficient Resources, 2008, http://www.deeresources.com/deer0911planning/downloads/EUL_Summary_10-1-08.xls

Parameter	Description	Value	Source
Daily Hrs.	Daily Operating Hours	12 hours	FSTC
Preheat Time	Time to Preheat (Min)	15 Minutes	FSTC
E_{food}	ASTM defined Energy to Food	0.139 kWh/lb, 475 Btu/if	FSTC
Days	Number of Days of operation	365 Days	FSTC
CookEff	Cooking Energy Efficiency (%)	For Electric, see Table 414 For Gas, see Table 415	FSTC
IdleEnergy	Idle energy rate (kW), (Btu/h)		FSTC, ENERGY STAR®
Capacity	Production capacity (lbs./hr)		FSTC
Preheat Energy	kWh/day, Btu/day		FSTC
LB_{Food}	Food cooked per day (lb/day)		FSTC

General assumptions used for deriving deemed electric and gas savings are values are taken from the Food Service Technology Center (FSTC) work papers.[353] These deemed values assume that the griddles are 3 x 2 feet in size. Parameters in the table are per linear foot, with an assumed depth of 2 feet.

Table 194: Baseline and Efficient Assumptions for Electric Griddles

[352] Assumptions based on PG&E Commercial Griddles Work Paper developed by FSTC, May 22, 2012.

[353] FSTC food service equipment work papers submitted to CPUC for Energy Efficiency 2013-2014 Portfolio; document titled EnergyEfficiency2013-2014-Portfolio_Test_PGE_20120702_242194.zip

https://www.pge.com/regulation/EnergyEfficiency2013-2014-Portfolio/Testimony/PGE/2012/EnergyEfficiency2013-2014-Portfolio_Test_PGE_20120702_242194.zip.

Parameter	Baseline Electric Griddles	Efficient Electric Griddles
Preheat Energy (kWh/ft.)	1.33	0.67
Idle Energy Rate (kW/ft.)	0.8	0.64
Cooking Energy Efficiency (%)	65%	70%
Production Capacity (lbs./h/ft.)	11.7	16.33
Lbs. of food cooked/day/ft.	33.33	33.33

Peak Demand Savings can be derived by dividing the annual energy savings by the operating Equivalent hours and multiplying by the Coincidence Factor.

$$\Delta kW = \left(\frac{\Delta kWh}{HOURS}\right) \times CF$$

Where:

ΔkWh = Annual energy savings (kWh)

4380 = Operating Equivalent hours = 365 x 12 = 4380 hours

0.84[354] = Coincidence Factor (CF)

C.5.1.5. Deemed Savings Values

Deemed savings based on the assumptions above are tabulated below per griddle, per linear foot.

Table 195: Deemed Savings for Electric and Gas Commercial Griddles per Linear Foot

354 Coincidence factors utilized in other jurisdictions for Commercial Griddles vary from 0.84 to 1.0. The KEMA report titled "Business Programs: Deemed Savings Parameter Development," November 2009 conducted for Wisconsin Focus on Energy lists Coincidence Factors by building type and identifies food service at 0.84.

Measure Description	*Deemed Savings per Griddle per linear foot*	
	kW	*kWh*
Griddle, Electric, ENERGY STAR®	0.15	758

C.5.1.6. Incremental Cost

The incremental cost is $60 per linear foot of width of the unit[355].

C.5.1.7. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using default values from FSTC. If this measure is added to Energy Smart programs, the evaluation should include an assessment of actual usage schedules to replace the default FSTC schedule values.

[355] Measure cost from ENERGY STAR which cites reference as "EPA research on available models using AutoQuotes, 2010" http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=COG

C.5.2. Convection Ovens

C.5.2.1. Measure Description

High efficiency ovens exhibit better baking uniformity and higher production capacities while also including high-quality components and controls.

C.5.2.2. Estimated Useful Life (EUL)

According to the California Database of Energy Efficiency Resources (DEER 2014), all commercial ovens are assigned an estimated useful life (EUL) of 12 years.[356]

C.5.2.3. Baseline and Efficiency Standards

Efficient convection ovens are defined by ENERGY STAR® or its equivalent and apply to electric full-size and half-size convection ovens and gas full-size convection ovens. Full size ovens accept a minimum of five pans measuring 18 x 26 x 1-inch. Half size ovens accept a minimum of five sheet pans measuring 18 x 13 x 1-inch. The ENERGY STAR® criteria should be reviewed on an annual basis to reflect the latest requirements.

There are currently no federal minimum standards for Commercial Convection Ovens, however, the American Society of Testing and Materials (ASTM) publishes Test Methods[357] that allow uniform procedures to be applied to each commercial cooking appliance for a fair comparison of performance results.

Table 196: ENERGY STAR® Criteria for Electric Convection Ovens[358]

Performance Parameters	*Half Size Electric Ovens*	*Full Size Electric Ovens*
Heavy-Load Cooking Energy Efficiency	≥71%	≥71%
Idle Energy Rate	≤1.0 kW	≤1.6 kW

[356] Database for Energy Efficient Resources, 2008, http://www.deeresources.com/deer0911planning/downloads/EUL_Summary_10-1-08.xls

[357] The industry standard for energy use and cooking performance of convection ovens is ASTM F-2861-10, Standard Test Method for Enhanced Performance of Combination Oven in Various Modes.

[358] ENERGY STAR® Commercial Ovens Version 1.1, effective May 2009; Version 2.0 is currently under development to be releas`qed by 2013. New efficiency levels will be identified and scope will add Combination Ovens.

C.5.2.4. Calculation of Deemed Savings

Annual savings can be calculated by determining the energy consumed by a standard efficiency convection oven as compared with an ENERGY STAR® rated convection oven.

$$\Delta kWh = kWhbase - kWheff$$

$$kWh(base\ or\ eff) = kWhcooking + kWhidle + kWhpreheat$$

$$kWhcooking = \left(LB \times \frac{Efood}{CookEff}\right) \times Days$$

$$kWhidle = IdleEnergy \times \left(DailyHrs - \frac{LB}{Capacity} - \frac{PreheatTime}{60}\right) \times Days$$

$$kWhpreheat = PreheatEnergy \times Days$$

General assumptions in Table 197 are from the ENERGY STAR® Commercial Kitchen Equipment Savings Calculator – Convection Ovens which refers to the Food Service Technology Center (FSTC) work papers and research.[359]

Table 197: Baseline and Efficient Assumptions for Electric Convection Ovens

Parameter	Half Size Electric Ovens		Full Size Electric Ovens	
	Baseline Model	Efficient Model	Baseline Model	Efficient Model
Preheat Energy (kWh/ft.)	1	0.9	1.5	1
Idle Energy Rate (kW/ft.)	1.5	1	2	1.6
Cooking Energy Efficiency (%)	65%	71%	65%	71%
Production Capacity (lbs./h/ft.)	45	50	70	80
Lbs. of food cooked/day/ft.	100	100	100	100
Efood (kWh/lb)	0.0732	0.0732	0.0732	0.0732

[359] FSTC food service equipment work papers submitted to CPUC for Energy Efficiency 2013-2014 Portfolio; document titled EnergyEfficiency2013-2014-Portfolio_Test_PGE_20120702_242194.zip

Peak Demand Savings can be derived by dividing the annual energy savings by the operating Equivalent hours and multiplying by the Coincidence Factor.

$$\Delta kW = \left(\frac{\Delta kWh}{HOURS}\right) \times CF$$

Where:

ΔkWh = Annual energy savings (kWh)

$HOURS$ = Operating Equivalent hours = 365 x 12 = 4,380 hours[360]

CF = Coincidence Factor = 0.84[361]

C.5.2.5. Deemed Savings Estimates for Convection Ovens

Deemed savings based on the assumptions above are tabulated below for electric convection ovens.

Table 198: Deemed Savings Estimates for Electric Convection Ovens

Measure Description	***Deemed Savings per Oven***	
	kW	***kWh***
Half Size Convection Oven, Electric, ENERGY STAR®	0.39	2,042
Half Size Convection Oven, Electric, ENERGY STAR®	0.37	1,933
Half Size Convection Oven, Electric, ENERGY STAR®	0	0

C.5.2.6. Incremental Cost

The incremental cost for this measure is $50.[362]

[360] ENERGY STAR® Commercial Kitchen Equipment Savings Calculator – Convection Ovens assumes an operating time of 12 hours.

[361] KEMA report titled "Business Programs: Deemed Savings Parameter Development," November 2009 conducted for Wisconsin Focus on Energy lists Coincidence Factors by building type and identifies food service at 0.84.

[362] Measure cost from ENERGY STAR which cites reference as "EPA research on available models using AutoQuotes, 2010" http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=COG

C.5.3. Combination Ovens

Combination ("Combi") ovens are convection ovens with a steam cooking mode.

C.5.3.1. Baseline and Efficiency Standards

There are currently no federal minimum standards for Commercial Combination Ovens, however, the American Society of Testing and Materials (ASTM) publishes Test Methods611 that allow uniform procedures to be applied to each commercial cooking appliance for a fair comparison of performance results.

As of January 1, 2014, efficient combination ovens are defined by ENERGY STAR® and apply to both electric and gas ovens. Combination ovens combines the function of hot air convection (oven mode), saturated and superheated steam heating (steam mode), and combination convection/steam mode for moist heating, to perform steaming, baking, roasting, rethermalizing, and proofing of various food products.

Table 199: High Efficiency Requirements for Electric Combination Ovens by Pan Capacity

Mode	***Idle Rate***	***Cooking Efficiency (%)***
Electric, where P is ≥ 5 and ≤ 20		
Steam Mode	≤ 0.133P + 0.64 kW	≥ 55%
Convection Mode	≤ 0.08P + 0.4989 kW	≥ 76%

C.5.3.2. Calculation of Deemed Savings

Annual savings can be calculated by determining the energy consumed by a standard efficiency combination oven as compared with a high efficiency combination oven.

For electric savings,

$$\Delta kWh = kWhtotal,base - kWhtotal,eff$$

$$kWh(total,base\ or\ total,eff) = kWhoven + kWhsteam + kWhpreheat$$

$$kWh(oven\ or\ steam) = kWhcooking + kWhidle$$

$$kWhcooking\ (oven\ or\ steam) = (LBoven\ or\ steam \times \frac{Efood}{\text{CookEff}}) \times Days$$

Where $LB_{ove}n$ = LB × (1-% Steam) and LB_{steam} = LB × % Steam

$$kWhidle(oven) = (1 - \%Steam) \times IdleEnergy \times (DailyHrs - LBovenCapacity - nP \times PreheatTime60) \times Days$$

$$kWhidle(steam) = (\%Steam) \times IdleEnergy \times (DailyHrs - LBsteamCapacity - np \times PreheatTime60) \times Days$$

$$kWhpreheat = nP \times PreheatEnergy \times Days$$

Key parameters used to compute savings are listed in Table 430, Table 431, and Table 432.

Table 200: Energy Consumption Parameters for Commercial Combination Ovens

Parameter	**Description**	**Value**	**Source/Approach**
Daily Hrs.	Daily Operating Hours	12 hours	ENERGY STAR® Commercial Kitchen Equipment Calculator
Preheat Time	Time to Preheat (Min)	15 min	FSTC Life Cycle & Energy Cost Calculator
nP	Number of Preheats per Day	1/day	FSTC Life Cycle & Energy Cost Calculator
$E_{food,oven}$	ASTM defined Energy to Food for Convection Ovens	0.0732 kWh/lb	ASTM
$E_{food,steam}$	ASTM defined Energy to Food for Steam Cookers	0.0308 kWh.lb,	ASTM
Days	Number of day of operation	365 days	ENERGY STAR® Commercial Kitchen Equipment Calculator
% Steam	Percent of time in Steam Mode	50%	ENERGY STAR® Commercial Kitchen Equipment Calculator
CookEff	Cooking energy efficiency (%)	See Table 199	Baseline: Average from ENERGY STAR® and FSTC Calculators[363]
IdleEnergy	Idle energy rate (kW), (Btu/h)		

[363] Baseline cooking efficiencies and idle energy rates were averaged between the ENERGY STAR® Food Service Appliance Calculator and the FSTC food service life cycle cost calculator.

Capacity	Production capacity (lbs./hr)		Average from ENERGY STAR® Qualifying Products Listing
Preheat Energy	kWh/day, Btu/day		FSTC Life Cycle & Energy Cost Calculator ENERGY STAR® Products Listing
$LB_{oven,steam}$	Food cooked per day (lb/day) in steam mode or oven mode		ENERGY STAR® Commercial Kitchen Equipment Calculator

General assumptions used for deriving deemed electric and gas savings are defined in the following tables. These values were taken from the ENERGY STAR® Food Service Appliance Calculator as well as the Food Service Technology Center (FSTC) Life Cycle and Energy Cost Calculator.

C.5.3.3. Incremental Cost

The incremental cost is $800[364].

C.5.3.4. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using default values from FSTC. If this measure is added to Energy Smart programs, the evaluation should include an assessment of actual usage schedules to replace the default FSTC schedule values.

[364] ENERGY STAR Commercial Food Service Calculator

C.5.4. Commercial Fryers

C.5.4.1. Measure Description

This measure applies to ENERGY STAR® or its equivalent electric commercial open-deep fat fryers in retrofit and new construction applications. Commercial fryers consist of a reservoir of cooking oil that allows food to be fully submerged without touching the bottom of the vessel. Electric fryers use a heating element immersed in the cooking oil.

High efficiency standard and large vat fryers offer shorter cook times and higher production rates through the use of advanced burner and heat exchanger design. Standby losses are reduced in more efficient models through the use of fry pot insulation.

C.5.4.2. Baseline & Efficiency Standard

Key parameters for defining fryer efficiency are Heavy Load Cooking Energy Efficiency and Idle Energy Rate. ENERGY STAR® requirements apply to a standard fryer and a large vat fryer. A standard fryer measures 14 to 18 inches wide with a vat capacity from 25 to 60 pounds. A large vat fryer measures 18 inches to 24 inches wide with a vat capacity greater than 50 pounds. The ENERGY STAR® criteria should be reviewed on an annual basis to reflect the latest requirements.

There are currently no federal minimum standards for Commercial Fryers, however, ASTM publishes Test Methods[365] that allow uniform procedures to be applied to each commercial cooking appliance for a fair comparison of performance results.

Table 201: ENERGY STAR® Criteria[366] and FSTC Baseline for Open Deep-Vat Electric Fryers

Performance Parameters	ENERGY STAR® Electric Fryer Criteria	
	Standard Fryers	Large Vat Fryers
Heavy-Load Cooking Energy Efficiency	≥ 80%	≥ 80%
Idle Energy Rate	≤ 1.0 kW	≤ 1.1 kW

[365] The industry standards for energy use and cooking performance of fryers are ASTM Standard Test Method for the Performance of Open Deep Fat Fryers (F1361) and ASTM Standard Test Method for the Performance of Large Vat Fryers (FF2144).

[366]

C.5.4.3. Estimated Useful Life (EUL)

According to DEER 2014, commercial fryers are assigned an estimated useful life (EUL) of 12 years.[367]

C.5.4.4. Calculation of Deemed Savings

Annual savings can be calculated by determining the energy consumed by a standard efficiency fryer as compared with an ENERGY STAR® rated fryer.

$$\Delta kWh = kWhbase - kWheff$$

$$kWh(base\ or\ eff) = kWhcooking + kWhidle + kWhpreheat$$

$$kWhcooking = \left(LB \times \frac{Efood}{CookEff}\right) \times Days$$

$$kWhidle = IdleEnergy \times \left(DailyHrs - \frac{LB}{Capacity} - \frac{PreheatTime}{60}\right) \times Days$$

$$kWhpreheat = PreheatEnergy \times Days$$

Key parameters used to compute savings are defined in Table 202.

Table 202 Energy Consumption Related Parameters for Commercial Fryers[368]

[367] Database for Energy Efficient Resources, 2008, http://www.deeresources.com/deer0911planning/downloads/EUL_Summary_10-1-08.xls

Parameter	Description	Value	Source
Daily Hrs.	Daily Operating Hours	12 hours	FSTC
Preheat Time	Time to Preheat (Min)	15 Minutes	FSTC
E_{food}	ASTM defined Energy to Food	0.167 kWh/lb, 570 Btu/lb.	FSTC
Days	Number of Days of operation	365 Days	FSTC
CookEff	Cooking Energy Efficiency (%)	For Electric, see Table 437 For Gas, see Table 438	FSTC
IdleEnergy	Idle energy rate (kW), (Btu/h)		FSTC, ENERGY STAR®
Capacity	Production capacity (lbs./hr)		FSTC
Preheat Energy	kWh/day, Btu/day		FSTC
LB	Food cooked per day (lb/day)		FSTC

General assumptions used for deriving deemed electric and gas savings are defined in the following tables. These values are taken from the ENERGY STAR® Commercial Kitchen Equipment Savings Calculator as well as the Food Service Technology Center (FSTC) work papers and research.

Table 203: Baseline and Efficient Assumptions for Electric Standard and Large Vat Fryers

[368] Assumptions based on PG&E Commercial Fryers Work Paper developed by FSTC, June 13, 2012

Parameter	*Baseline Electric Fryers*		*Efficient Electric Fryers*	
	Standard	*Large Vat*	*Standard*	*Large Vat*
Preheat Energy (kWh/ft.)	2.3	2.5	1.7	2.1
Idle Energy Rate (kW/ft.)	1.05	1.35	1	1.1
Cooking Energy Efficiency (%)	75%	70%	80%	80%
Production Capacity (lbs./h/ft.)	65	100	70	110
Lbs. of food cooked/day/ft.	150	150	150	150

Peak Demand Savings can be derived by dividing the annual energy savings by the operating Equivalent hours and multiplying by the Coincidence Factor.

$$\Delta kW = \left(\frac{\Delta kWh}{HOURS}\right) \times CF$$

Where:

ΔkWh = Annual energy savings (kWh)

$HOURS$ = Operating equivalent hours = 365 x 12 = 4,380

CF = Coincidence factor = 0.84[369]

C.5.4.5. Deemed Savings Values

Deemed savings using the assumptions above are tabulated below. These values are per installed unit based on the type of fryer.

Table 204: Deemed Savings per Fryer Vat

Measure Description	*Deemed Savings per*

[369] Coincidence factors utilized in other jurisdictions for Commercial Fryers vary from 0.84 to 1.0. The KEMA report titled "Business Programs: Deemed Savings Parameter Development," November 2009 conducted for Wisconsin Focus on Energy lists Coincidence Factors by building type and identifies food service at 0.84.

	Fryer Vat	
	kWh	**kW**
Fryer, Electric, ENERGY STAR®	0.2	1,057
Fryer, Large Vat, Electric, ENERGY STAR®	0.51	2,659

C.5.4.6. Incremental Cost

The incremental cost is $1,200[370].

C.5.4.1. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using default values from FSTC. If this measure is added to Energy Smart programs, the evaluation should include an assessment of actual usage schedules to replace the default FSTC schedule values.

[370] cost from ENERGY STAR which cites reference as "EPA research on available models using AutoQuotes, 2010" http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=COG

C.5.5. Commercial Steam Cookers

C.5.5.1. Measure Description

This measure applies to ENERGY STAR® or its equivalent electric steam cookers in retrofit and new construction applications. Commercial steam cookers, also known as "compartment steamers," vary in configuration and size based on the number of pans. High efficiency steam cookers offer shorter cook times, higher production rates and reduced heat loss due to better insulation and more efficient steam delivery system.

C.5.5.2. Baseline & Efficiency Standard

Key parameters for defining steam cookers efficiency are Heavy Load Cooking Energy Efficiency and Idle Energy Rate. ENERGY STAR® requirements apply to steam cookers based on the pan capacity. These criteria should be reviewed on an annual basis to reflect the latest ENERGY STAR® requirements.

There are currently no federal minimum standards for Commercial Steam Cookers, however, ASTM publishes Test Methods[371] that allow uniform procedures to be applied to each commercial cooking appliance for a fair comparison of performance results.

Table 205: ENERGY STAR® Criteria for Electric Steam Cookers[372]

Pan Capacity	Cooking Efficiency	Idle Rate (watts)
3-pan	50%	400
4-pan	50%	530
5-pan	50%	670
6-pan and larger	50%	800

Table 206: ENERGY STAR® Criteria for Gas Steam Cookers[373]

Pan Capacity	Cooking Efficiency	Idle Rate (Btu/h)
5-pan	38%	10,400

[371] The industry standard for steam cookers energy use and cooking performance is ASTM Standard F1484-99, Test Method for the Performance of Steam Cookers/

[372] ENERGY STAR® Commercial Steam Cookers Version 1.2, effective August 1, 2003.

[373] ENERGY STAR® provides criteria for 3-pan, 4-pan but availability of products in this range is limited or unavailable.

6-pan and larger	38%	12,500

C.5.5.3. Estimated Useful Life (EUL)

According to DEER 2014, steam cookers are assigned an estimated useful life (EUL) of 12 years.

C.5.5.4. Calculation of Deemed Savings

Energy savings for steam cookers is derived by determining the total energy consumed by standard steam cooker as compared with an ENERGY STAR® rated steam cooker. Total energy for a steam cooker includes the energy used during cooking, the energy used when the equipment is idling, the energy spent when set in a constant steam mode and the energy required during pre-heat.

$$\Delta Energy = Energybase, total - Energyeff, total$$

$$Energy(base, total\ or\ eff, total) = Energycooking + Energyidle + Energysteam + Energypreheat$$

where,

$$Energycooking = LB\ food \times EfoodCook\ Eff \times Days$$

$$Energyidle = (1 - \%Steam) \times IdleEnergy \times \left(DailyHrs - \frac{LBfood}{Capacity} - \frac{PreheatTime}{60}\right) \times Days$$

$$Energysteam = (\%Steam) \times \frac{Capacity \times Efood}{Cook\ Eff} \times \left(DailyHrs - \frac{LBfood}{Capacity} - \frac{PreheatTime}{60}\right) \times Days$$

$$Energypreheat = PreheatEnergy \times Days$$

General assumptions used for deriving deemed electric savings are defined in the following tables. These values are taken from the ENERGY STAR® Commercial Kitchen Equipment Savings Calculator as well as the Food Service Technology Center (FSTC) work papers and research.

Table 207: Energy Consumption Related Parameters for Commercial Steam Cookers

Parameter	***Description***	***Value***	***Source/Approach***
Daily Hrs.	Daily Operating Hours	12 hours	FSTC
Preheat Time	Steam Cooker Preheat Time (Min)	15 min	FSTC
E_{food}	ASTM defined Energy to Food	0.0308 kWh/lb, 105 Btu/lb	FSTC
Days	Number of day of operation	365 days	FSTC
CookEff	Cooking energy efficiency (%)	For Electric, see Table 437 For Gas, see Table 438	FSTC
IdleEnergy	Idle energy rate (kW), (Btu/h)		FSTC, ENERGY STAR®
%Steam	Constant Steam energy use		FSTC
Capacity	Production capacity (lb/hr)		ENERGY STAR®
Preheat Energy	kWh/day, Btu/day		ENERGY STAR®
LB_{food}	Food cooked per day (lb/day)		ENERGY STAR®

Table 208: Deemed Savings Assumptions for Electric Steam Cookers

Parameter	***Baseline Model***	***Efficient Electric Model***
Cooking Efficiency (%)	26%	50%
Preheat Energy (Btu)	1.5	1.5
Constant Steam Mode Time (%)	0.9	0.1
Lbs. of food Cooked/Day	100	100
Production Capacity (lbs./hr/pan)	23.33	16.67
Idle Energy Rate (kW/pan)	0.33	0.13

Peak Demand Savings can be derived by dividing the annual energy savings by the operating Equivalent hours and multiplying by the Coincidence Factor.

$$\Delta kW = \left(\frac{\Delta kWh}{HOURS}\right) \times CF$$

Where:

ΔkWh = Annual energy savings (kWh)

4380 = Operating Equivalent hours = 365 x 12 = 4380 hours

0.84[374] = Coincidence Factor (CF)

C.5.5.5. Deemed Savings Values

Deemed savings are per installed unit based on the number of pans per steam cooker.

[374] Coincidence factors utilized in other jurisdictions for Commercial Steam Cookers vary from 0.84 to 1.0. The KEMA report titled "Business Programs: Deemed Savings Parameter Development," November 2009 conducted for Wisconsin Focus on Energy lists Coincidence Factors by building type and identifies food service at 0.84.

Table 209: Deemed Savings for Steam Cookers

Measure Description	Deemed Savings	
	kW	kWh
Steam Cooker, Electric, 3-pan - ENERGY STAR®	5.4	28,214
Steam Cooker, Electric, 4-pan - ENERGY STAR®	7.3	38,081
Steam Cooker, Electric, 5-pan - ENERGY STAR®	9.2	47,948
Steam Cooker, Electric, 6-pan - ENERGY STAR®	11.1	57,815

C.5.5.1. Incremental Cost

The incremental cost is $2,490[375].

C.5.5.1. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. As a result, savings are calculated using default values from FSTC. If this measure is added to Energy Smart programs, the evaluation should include an assessment of actual usage schedules to replace the default FSTC schedule values.

[375] 32Source for efficient electric steamer incremental cost is $2,490 per 2009 PG&E Workpaper - PGECOFST104.1 - Commercial Steam Cooker - Electric and Gas as reference by KEMA in the ComEd C & I TRM.

C.5.6. Low-Flow Pre-Rinse Spray Valves

C.5.6.1. Measure Description

This measure consists of installing low-flow pre-rinse spray valves which reduce hot water use and save energy associated with heating the water. The low-flow pre-rinse spray valves have the same cleaning effect as the existing standard spray valves even though they use less water.

C.5.6.2. Baseline & Efficiency Standard

The savings values for low-flow pre-rinse spray valves are applicable for the retrofit of existing operational pre-rinse spray valves with an average flow rate of 1.9 gallons per minute. This average is based on an assumed combination of pre- and post-2006 PRSVs, which have code requirements of 2.25 and 1.6 GPM, respectively.

The maximum flow rate of qualifying low-flow pre-rinse spray valves is 1.28 gallons per minute.[376]. To qualify for savings the facility must have electric domestic hot water equipment.

C.5.6.3. Estimated Useful Life (EUL)

The effective useful life (EUL) for this measure is 5 years.[377]

C.5.6.4. Deemed Savings Values

Table 210: Variables for the Deemed Savings Algorithm

Facility Type	Days/Year	Minutes/Day	kWh	kW
Fast Food	365	45	1,795	0.25
Casual Dining	365	105	4,188	0.46
Institutional	365	210	8,375	0.69
Dormitory	274	210	6,287	0.92
K-12 School	200	105	2,295	0.57

[376] FEMP Performance Requirements for Federal Purchases of Pre-Rinse Spray Valves, Based on ASTM F2324-03: Standard Test Method for Pre-Rinse Spray Valves.

[377] FEMP Purchasing Specification for Energy-Efficiency Products, Pre-Rinse Spray Valves: http://www1.eere.energy.gov/femp/pdfs/pseep_spray_valves.pdf

C.5.6.5. Calculation of Deemed Savings

Annual gas savings and peak day gas savings can be calculated by using the following equations:

$$\Delta Therms = \frac{\rho \times CP \times U \times (FB - FP) \times (TH - TSupply) \times \frac{1}{Et} \times \frac{Days}{Year}}{100{,}000\ BTU/Therm}$$

$$\Delta Peak\ Therms = \frac{\Delta Therms}{\frac{\text{Days}}{\text{Year}}}$$

Annual kWh electric and peak kW savings can be calculated using the following equations and Table 211 summarizes the needed variables:

$$\Delta kWh = \frac{\rho \times CP \times U \times (FB - FP) \times (TH - TSupply) \times \frac{1}{Et} \times \frac{Days}{Year}}{3412 BTU/kWh}$$

$$\Delta kW = \frac{\rho \times CP \times U \times (FB - FP) \times (TH - TSupply) \times \frac{1}{Et} \times P}{3412 BTU/kWh}$$

Table 211: Variables for the Deemed Savings Algorithm

Parameter	Description	Value
F_B	Average baseline flow rate of sprayer (GPM)	2.25
F_P	Average post measure flow rate of sprayer (GPM)	1.28
Days/Year	Annual Operating Days for the applications: See Table 451 for building type definitions:	
	1. Fast Food Restaurant	365[378]
	2. Casual Dining Restaurant	365
	3.Institutional	365

[378] Osman S &. Koomey, J. G. , . Lawrence Berkeley National Laboratory 1995. *Technology Data Characterizing Water Heating in Commercial Buildings: Application to End-Use Forecasting.* December.

	4. Dormitory	274[379]
	5. K-12 School	200
T_{supply}	Average supply (cold) water temperature (°F)	74.8
T_H	Average mixed hot water (after spray valve) temperature (°F)	120[380]
U_B	Baseline water usage duration for the following applications:	
	1. Fast Food Restaurant (see Table 451 - small service)	45 min/day/unit[381]
	2. Casual Dining Restaurant (see Table 452 - medium service)	105 min/day/unit
	3. Institutional (see Table 452 - large service)	210 min/day/unit
	4. Dormitory (see Table 452 - large service)	210 min/day/unit
	5. K-12 School (see Table 452 - medium service)	105 min/day/unit[382]
ρ	Density of water 8.33 BTU/Gallon	8.33
C_P	Heat capacity of water	1
E_t	Thermal efficiency of water heater	Default value 0.98 for electric and 0.80 for gas
P	Hourly peak demand as a fraction of daily water consumption for the following applications:	

[379]For dormitories with few occupants in the summer: 365 x (9/12) = 274.

[380] According to ASTM F2324 03 Cleanability Test the optimal operating conditions are at 120ºF.

[381] CEE Commercial Kitchens Initiative Program Guidance on Pre-Rinse Valves.

[382] School mealtime duration is assumed to be half of that of institutions, assuming that institutions (e.g. prisons, university dining halls, hospitals, nursing homes) serve three meals per day at 70 minutes each, and schools serve breakfast to half of the students and lunch to all, yielding 105 minutes per day.

	1. Fast food restaurant (Fast Food)	0.05[383]
	2. Casual Dining Restaurant (Sit Down Rest.)	0.04[384]
	3. Institutional (Nursing Home)	0.03
	4. Dormitory (Sit Down Rest.)	0.04
	5. K-12 School (High School)	0.05

[383] ASHRAE Handbook 2011. HVAC Applications. Chapter 50 –Service Water Heating. American Society of Heating Refrigeration and Air Conditioning Engineers, Inc. (ASHRAE) 2011. ASHRAE, Inc., Atlanta, GA.

[384] Maintenance factor of 0.01 is the average maintenance factor for gas furnaces taken from the October 2010 National Renewable Energy publication "Building America House Simulation Protocols," Table 30

Table 212: Building Type Definitions

Building Type	Operating Days per Year	Representative PRSV Usage Examples
1. Fast food restaurant	365	Establishments engaged in providing food services where patrons order and pay before eating. These facilities typically use disposable serving ware. PRSV are used for rinsing cooking ware, utensils, trays, etc. Examples: Fast food restaurant, supermarket food preparation and food service area, drive-ins, grills, luncheonettes, sandwich, and snack shops.
2. Casual dining restaurant	365	Establishments primarily engaged in providing food services to customers who order and are served while seated (i.e. waiter/waitress service). These facilities typically use chinaware and use the PRSV to rinse dishes, cooking ware, utensils, trays, etc. Example: Full meal restaurant.
3. Institutional	365	Establishments located in institutional facilities (e.g. nursing homes, hospitals, prisons, military) where food is prepared in large volumes and patrons order food before eating, such as in dining halls and cafeterias. These facilities typically use disposable serving ware and serving trays. PRSVs are used for rinsing cooking ware, utensils, tray, etc. Examples: Nursing home, hospital, prison cafeteria, and military barrack mess hall.
4. Dormitory	274	Establishments located in higher education facilities where food is prepared in large volumes and patrons order food before eating, such as in dining halls and cafeterias. These facilities typically use disposable serving ware and serving trays. PRSVs are used for rinsing cooking ware, utensils, trays, etc. Example: University dining halls.
5. K-12 School	200	Establishments located in K-12 schools where food is

		prepared in large volumes and patrons order food before eating, such as in dining halls and cafeterias. These facilities typically use disposable serving ware and serving trays. PRSVs are used for rinsing cooking ware, utensils, trays, etc. Example: K-12 school cafeterias

Table 213: Daily Operating Hours

Food Service Operation	Min (Min/Day)	Max (Min/Day)	Average (Min/Day)
Small Service (e.g., quick-service restaurants)	30	60	45
Medium Service (e.g., casual dining restaurants)	90	120	105
Large Service (e.g., institutional such as cafeterias in universities, prisons, and nursing homes)	180	240	210

The following are example calculations for a fast food restaurant in New Orleans using the previous equations.

$$\Delta kWh = \frac{8.33\ x\ 45\ minday\ x\ [1.9 - 1.28]GPM\ x\ (120 - 74.8°\text{F})x\ \left(\frac{1}{0.98}\right)\ x\ \frac{365\ days}{year}}{3412\ BTU\ kWh}$$

$$= 1101\ kWh$$

$$\Delta kW = \frac{0.05\ x\ 8.33\ x\ 45\ minday\ x\ (1.9 - 1.28)GPM\ x\ (120 - 74.8°\text{F})\ x\ \left(\frac{1}{0.98}\right)}{3412\ BTU\ kWh} = 0.15\ kW$$

C.5.6.6. Incremental Cost

When available program-actual costs should be used. If unknown, use a default value of \$92.90[385].

[385] Average of costs recognized by Ameren Missouri (\$85.8) and KCPL (\$100).

C.5.6.1. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. If this measure is incorporated into Energy Smart, ADM recommends studying the following parameters:

- DHW setpoint;
- Flow rate of installed PRSVs;
- Flow rate of baseline PRSVs (to be collected by the program implementer and sent to ADM for testing).

C.6. Commercial Lighting

C.6.1. Light Emitting Diode (LED) Traffic Signals

C.6.1.1. Measure Description

This measure involves the installation of LED traffic signals, typically available in red, yellow, green, and pedestrian format, at a traffic light serving any intersection in retrofit applications. New construction applications are not eligible for this measure, as incandescent traffic signals are not compliant with the current federal standard[386], effective January 1, 2006.

C.6.1.2. Baseline and Efficiency Standards

For all retrofit projects, the baseline is a standard incandescent fixture.

Due to the increased federal standard for traffic signals, the ENERGY STAR® LED Traffic Signal specification was suspended effective May 1, 2007.[387] ENERGY STAR® chose to suspend the specification rather than revise it due to minimal additional savings that would result from a revised specification. Because the ENERGY STAR® specification no longer exists, the efficiency standard is considered to be an equivalent LED fixture for the same application. The equivalent LED fixture must be compliant with the federal standard. There is no current federal standard for yellow "ball" or "arrow" fixtures.

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[386] Current federal standards for traffic and pedestrian signals can be found at the DOE website at: http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/32.

[387] Memorandums related to this decision can be found on the ENERGY STAR® website at: https://www.energystar.gov/index.cfm?c=archives.traffic_signal_spec.

Table 214: Federal Standard Maximum Nominal Wattages[388], Wattages[389], and Deemed savings

Measure	***Nominal Wattage***	***Maximum Wattage***
12” Red Ball	17	11
12” Green Ball	15	15
8” Red Ball	13	8
8” Green Ball	12	12
12” Red Arrow	12	9
8” Green Arrow	11	11
Combination Walking Man/Hand	16	13
Walking Man	12	9
Orange Hand	16	13

Typical incandescent and LED traffic signal fixture wattages can be found in the following table. These fixture wattages should be used in the absence of project specific fixture wattages.

[388] Nominal wattage is defined as power consumed by the module when it is operated within a chamber at a temperature of 25 °C after the signal has been operated for 60 minutes.

[389] Maximum wattage is the wattage at which power consumed by the module after being operated for 60 minutes while mounted in a temperature testing chamber so that the lensed portion of the module is outside the chamber, all portions of the module behind the lens are within the chamber at a temperature of 74 °C, and the air temperature in front of the lens is maintained at a minimum of 49 °C.

Table 215: Incandescent/LED Traffic Signal Fixture Wattages

Measure	Incandescent. Wattage[390]	LED Wattage[391]	kWh Savings	kW Savings
Replace 12" Red Incandescent Ball with 12" Red LED Ball	149	9	664.44	0.0756
Replace 12" Yellow Incandescent Ball with 12" Yellow LED Ball		17	34.716	0.0040
Replace 12" Green Incandescent Ball with 12" Green LED Ball		11	517.638	0.0593
Replace 8" Red Incandescent Ball with 8" Red LED Ball	86	6	379.68	0.0432
Replace 8" Yellow Incandescent Ball with 8" Yellow LED Ball		12	19.462	0.0022
Replace 8" Green Incandescent Ball with 8" Green LED Ball		6	300.08	0.0344
Replace 12" Red Incandescent Arrow with 12" Red LED Arrow	128	5	955.833	0.1095
Replace 12" Yellow Incandescent Arrow with 12" Yellow LED Arrow		8	31.56	0.0036
Replace 12" Green Incandescent Arrow with 12" Green LED Arrow		5	89.298	0.0098
Replace Large (16"x18") Incandescent Pedestrian Signal with LED Pedestrian Signal (with Countdown)	149	17	1140.744	0.1307
Replace Small (12"x12") Incandescent Pedestrian Signal with LED Pedestrian Signal (with Countdown)	107	10	838.274	0.0960
Replace Large (16"x18") Incandescent Pedestrian Signal with LED Pedestrian Signal (without Countdown)	116[392]	6	950.62	0.1089

[390] Northwest Power & Conservation Council: Regional Technical Forum. Commercial LED Traffic Signals measure workbook. http://rtf.nwcouncil.org/measures/measure.asp?id=114&decisionid=37.

[391] Typical practice for estimating fixture wattages is to take an average of the three leading manufacturers: GE, Philips, and Sylvania. Of the three, GE is the only manufacturer providing LED traffic signals. Other manufacturers excluded from averages. http://www.gelightingsolutions.com/products--solutions/transportation-led-lighting/traffic-signals.

[392] Average high wattage A19, A21, and A23 incandescent fixture from Philips and Sylvania.

Replace Small (12"x12") Incandescent Pedestrian Signal with LED Pedestrian Signal (without Countdown)	68[393]	5	544.446	0.0624

C.6.1.3. Estimated Useful Life (EUL)

According to the Northwest Power & Conservation Council Regional Technical Forum, the estimated useful life (EUL) is 5 to 6 years, as shown in the following table.

Table 216: Estimated Useful Life by Measure

Measure	***EUL[394] (Years)***
Replace 12" Red Incandescent Ball with 12" Red LED Ball	6
Replace 12" Yellow Incandescent Ball with 12" Yellow LED Ball	
Replace 12" Green Incandescent Ball with 12" Green LED Ball	
Replace 8" Red Incandescent Ball with 8" Red LED Ball	
Replace 8" Yellow Incandescent Ball with 8" Yellow LED Ball	
Replace 8" Green Incandescent Ball with 8" Green LED Ball	
Replace 12" Red Incandescent Arrow with 12" Red LED Arrow	
Replace 12" Yellow Incandescent Arrow with 12" Yellow LED Arrow	
Replace 12" Green Incandescent Arrow with 12" Green LED Arrow	
Replace Large (16"x18") Incandescent Pedestrian Signal with LED Pedestrian Signal	5
Replace Small (12"x12") Incandescent Pedestrian Signal with LED Pedestrian Signal	

C.6.1.4. Measure Savings Calculation

$$kW_{savings} = \sum\left(\left[N_{fixt(i)}\ x\ \frac{W_{fixt(i)}}{1000}\right]_{pre} - \left[N_{fixt(i)}\ x\ \frac{W_{fixt(i)}}{1000}\right]_{post}\right) x\ CF$$

$$kWh_{savings} = \sum\left(\left[N_{fixt(i)}\ x\ \frac{W_{fixt(i)}}{1000}\right]_{pre} - \left[N_{fixt(i)}\ x\ \frac{W_{fixt(i)}}{1000}\right]_{post}\right) x\ AOH$$

393 Ibid.

394 Northwest Power & Conservation Council: Regional Technical Forum. Commercial LED Traffic Signals measure workbook. http://rtf.nwcouncil.org/measures/measure.asp?id=114&decisionid=37. EUL is determined by LED Traffic Signal replacement schedule, which is set to precede earliest burnout. All fixtures will be replaced at the same time to minimize maintenance interruptions.

Where:

$N_{fixt(i),pre}$ = Pre-retrofit number of fixtures of type i.

$N_{fixt(i),post}$ = Post-retrofit number of fixtures of type i.

$W_{fixt(i),pre}$ = Rated wattage of pre-retrofit fixtures of type i (if unknown, use Table 215).

$W_{fixt(i),post}$ = Rated wattage of post-retrofit fixtures of type i (if unknown, use Table 215).

CF = Peak demand coincidence factor (Table 217).

AOH = Annual operating hours for specified measure type (Table 217).

Table 217: Coincidence Factor and Annual Operating Hours by Measure

Measure	CF[395]	AOH[396]
Replace 12" Red Incandescent Ball with 12" Red LED Ball	0.54	4,746
Replace 12" Yellow Incandescent Ball with 12" Yellow LED Ball	0.03	263
Replace 12" Green Incandescent Ball with 12" Green LED Ball	0.43	3,751
Replace 8" Red Incandescent Ball with 8" Red LED Ball	0.54	4,746
Replace 8" Yellow Incandescent Ball with 8" Yellow LED Ball	0.03	263
Replace 8" Green Incandescent Ball with 8" Green LED Ball	0.43	3,751
Replace 12" Red Incandescent Arrow with 12" Red LED Arrow	0.89	7,771
Replace 12" Yellow Incandescent Arrow with 12" Yellow LED Arrow	0.03	263
Replace 12" Green Incandescent Arrow with 12" Green LED Arrow	0.08	726
Replace Large (16"x18") Incandescent Pedestrian Signal with LED Pedestrian Signal	0.99	8,642
Replace Small (12"x12") Incandescent Pedestrian Signal with LED Pedestrian Signal	0.99	8,642

[395] CF = AOH / 8,760 hours

[396] Northwest Power & Conservation Council: Regional Technical Forum. Commercial LED Traffic Signals measure workbook. http://rtf.nwcouncil.org/measures/measure.asp?id=114&decisionid=37.

C.6.2. Lighting Controls

C.6.2.1. Measure Description

Automatic lighting controls save energy by switching off or dimming lights when they are not necessary. Some lighting control techniques, such as using photocell controls, can be coupled with a variety of control strategies, including daylighting controls, occupancy controls, timer controls, and time clocks.

C.6.2.1.1. Stepped Lighting Control Systems

When switching systems are used with entire circuits of lights, as opposed to individual light fixtures, the control protocol is usually described in terms of steps, with each “step” referring to a percentage of full lighting power. Stepped lighting control systems are a relatively inexpensive approach to controlling large individual spaces, but they can be distracting to occupants.

C.6.2.1.2. Continuous Dimming Control Systems

Continuous dimming control systems are designed to adjust electric lighting to maintain a designated light level. Continuous dimming systems eliminate distracting and abrupt changes in light levels, provide appropriate light levels at all times, and provide an increased range of available light level. Cost is the major disadvantage of this control.

C.6.2.1.3. Occupancy Sensors

Occupancy sensors use motion detection to control lights in response to the presence or absence of occupants in a space. Many different varieties of sensors are available, including passive infrared (PIR), Ultrasound detecting, dual-technology, and integral occupancy sensors. Occupancy sensors are most effective in spaces with sporadic or unpredictable occupancy levels.

C.6.2.1.4. Daylighting

Daylighting controls switch or dim electric lights in response to the presence or absence of daylight illumination in the space. Advanced daylighting controls incorporate occupancy and daylighting sensors into the same control.

C.6.2.2. Baseline and Efficiency Standards

IECC 2003 (Section 805.2) and IECC 2009 (Section 505.1) specify the conditions under which light reduction and automatic controls are mandatory for new construction and affected retrofit projects. See the Measure Baseline section under the lighting efficiency measure for a discussion of updated lighting fixture wattages.

There are no minimum efficiency requirements for lighting controls.

C.6.2.3. Estimated Useful Life (EUL)

According to DEER 2014, the estimated useful life (EUL) is eight years for Daylighting Sensors and eight years for Occupancy Sensors.

C.6.2.4. Deemed Savings

Due to the myriad of possible baseline lighting configurations upon which occupancy sensors may be installed, ADM has opted to not include deemed savings per-control. Such a value would require too many assumptions and is likely to be too in accurate to provide a fixed estimate. If the needed data cannot be collected by program implementers, then the project in question is ineligible for savings. The data requested to calculate deemed savings is consistent with what program implementers have historically collected in implementing Energy Smart programs and align with industry best practices for deemed savings for commercial lighting.

C.6.2.5. Calculation of Deemed Savings

C.6.2.5.1. *Measure/Technology Review*

There have been many in-depth studies performed on the energy savings associated with occupancy and daylighting controls. Research by various organizations – including the Illuminating Engineering Society (IES), Canada National Research Council (CNRC), New Buildings Institute (NBI), Lighting Research Center (LRC) and multiple utilities – was included in this review. A summary of the findings of these reports are located in Table 218 and

Table 219.

Table 218: Lighting Controls – Energy Saving Estimates for Occupancy Sensors

Location	IES[397]	CNRC[398]	NBI[399]	LRC[400]
Break Room	22%	-	-	-
Classroom	45%	63%	25%	-
Conference Room	43%	-	-	-
Corridor	-	24%	-	-
Office	32%	44%	35-45%	43%
Restroom	41%	-	-	-

Table 219: Lighting Controls – Energy Saving Estimates for Daylighting Sensors

Location	CNRC	NBI	SoCal Edison[401]	LRC
Classroom	16%	40%	-	-
Corridor	25%	-	-	-
Office	22%	35-40%	74%	24-59%
Grocery Stores	-	40%	-	-
Big Box Retail	-	60%	-	-

Lighting energy savings can be calculated using the following formula. The kWh savings for each combination of fixture type, fixture location, building type, and refrigeration type must be calculated separately:

$$kW_{savings} = N_{fixt} \times \frac{W_{fixt}}{1000} \times CF \times IEF_D$$

$$kWh_{savings} = N_{fixt} \times \frac{W_{fixt}}{1000} \times (1 - PAF) \times AOH \times IEF_E$$

397 IES HB-9-2000. *"Illuminating Engineering Society Lighting Handbook 9th Edition"*. 2000.

398 Canada National Research Center, *"Energy Savings from Photosensors and Occupant Sensors/Wall Switches"*. September 2009.

399 New Buildings Institute. 2010. http://buildings.newbuildings.org/.

400 Lighting Research Center (LRC), Solid State Lighting Program. http://www.lrc.rpi.edu/researchareas/leds.asp.

401 Southern California Edison, "*Energy Design Resources: Design Brief Lighting Controls*". February 2000.

Where:

N_{fixt} = Number of fixtures

W_{fixt} = Rated wattage of post-retrofit fixtures (Appendix E)

Note: If the fixture was retrofitted, use the installed fixture wattage; if fixture was not retrofitted, use the existing fixture wattage

PAF = Stipulated power adjustment factor based on control type (Table 220)

CF = Peak demand coincidence factor = 0.26[402]

AOH = Annual operating hours for specified building type (Table 227)

IEF_D = Interactive effects factor for demand savings (Table 228)

IEF_E = Interactive effects factor for energy savings (Table 228)

Table 220: Lighting Controls – Power Adjustment Factors[403]

Control Type	Power Adjustment Factor (PAF)
No controls measures	1.00
Daylighting Control – Continuous Dimming	0.70
Daylighting Control – Multiple Step Dimming	0.80
Daylighting Control – ON/OFF (Indoor)	0.90
Daylighting Control – ON/OFF (Outdoor) 404	1.00
Occupancy Sensor	0.70
Occupancy Sensor w/ Daylighting Control – Continuous Dimming	0.60
Occupancy Sensor w/ Daylighting Control – Multiple Step Dimming	0.65

402 RLW Analytics, "*2005 Coincidence Factor Study,"* Connecticut Energy Conservation Management Board. January 4, 2007. Default value applicable to all building types. This coincidence factor is a combination of the savings factor and peak coincidence factor.

403 ASHRAE 90.1-1989, Section 6.4.2.8 specifies that exterior lighting not intended for 24-hour continuous use shall be automatically switched by timer, photocell, or a combination of timer and photocell. This is consistent with current specifications in ASHRAE 90.1-2010, Section 9.4.1.3, which specifies that lighting for all exterior applications shall have automatic controls capable of turning off exterior lighting when sufficient daylight is available or when the lighting is not required during nighttime hours.

404 ASHRAE 90.1-1989, Section 6.4.2.8 specifies that exterior lighting not intended for 24-hour continuous use shall be automatically switched by timer, photocell, or a combination of timer and photocell. This is consistent with current specifications in ASHRAE 90.1-2010, Section 9.4.1.3, which specifies that lighting for all exterior applications shall have automatic controls capable of turning off exterior lighting when sufficient daylight is available or when the lighting is not required during nighttime hours.

Occupancy Sensor w/ Daylighting Control – ON/OFF	0.65

C.6.2.6. Incremental Costs

Incremental costs for lighting controls should use the full project cost. If not available, use the table below.

Table 221: Lighting Controls – Incremental Costs

Control Type	*Power Adjustment Factor (PAF)*
Daylighting Control – Continuous Dimming	$274[405]
Daylighting Control – Multiple Step Dimming	$274
Daylighting Control – ON/OFF (Indoor)	$274
Daylighting Control – ON/OFF (Outdoor) 406	$274
Occupancy Sensor	$42[407]
Occupancy Sensor w/ Daylighting Control – Continuous Dimming	$316
Occupancy Sensor w/ Daylighting Control – Multiple Step Dimming	$316
Occupancy Sensor w/ Daylighting Control – ON/OFF	$316

405 Consistent with the Multi-level Fixture measure with reference to Goldberg et al, State of Wisconsin Public Service Commission of Wisconsin, Focus on Energy Evaluation, Business Programs: Incremental Cost Study, KEMA, October 28, 2009. Also consistent with field experience of about $250 per fixture and $25 install labor.

406 ASHRAE 90.1-1989, Section 6.4.2.8 specifies that exterior lighting not intended for 24-hour continuous use shall be automatically switched by timer, photocell, or a combination of timer and photocell. This is consistent with current specifications in ASHRAE 90.1-2010, Section 9.4.1.3, which specifies that lighting for all exterior applications shall have automatic controls capable of turning off exterior lighting when sufficient daylight is available or when the lighting is not required during nighttime hours.

407 DEER 2014

C.6.3. Lighting Efficiency

C.6.3.1. Measure Description

A variety of high-efficiency fixtures, ballasts and lamps exist in the market today, producing the same lighting level (in lumens) as their standard-efficiency counterparts while consuming less electricity. This measure provides energy and demand savings calculations for the replacement of commercial lighting equipment with energy efficient lamps or fixtures. The operating hours and demand factors for the different building types listed in this measure are based on a wide array of information available in the market.

C.6.3.2. Baseline & Efficiency Standard

The following sections explain the various codes, standards, and required processes to establish the applicability of the Lighting Efficiency savings calculation method.

C.6.3.1. Deemed Savings

Due to the myriad of possible baseline lighting configurations, efficient configurations and facility parameters that contribute to a commercial lighting savings calculation, ADM has opted to not include deemed savings per-fixture. Such a value would require too many assumptions and is likely to be too in accurate to provide a fixed estimate. If the needed data cannot be collected by program implementers, then the project in question is ineligible for savings. The data requested to calculate deemed savings is consistent with what program implementers have historically collected in implementing Energy Smart programs and align with industry best practices for deemed savings for commercial lighting.

C.6.3.1.1. State Commercial Energy Codes

Louisiana's state commercial energy code recognizes ASHRAE 90.1-2007[408] for commercial structures. These standards specify the maximum lighting power densities (LPDs) by building type (building area method) and interior space type (space-by-space method). LPDs apply to all new construction and major renovation projects. The ASHRAE 90.1-2007 LPDs for various building types are outlined in Appendix F. Agricultural lighting for animals will utilize recognized industry standards unique to the requirements of that animal to determine the LPD for the building housing those animals.

[408] Any references to any versions of this standard refer to the American National Standards Institute (ANSI) /American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)/Illuminating Engineering Society of North America (IESNA) Standard 90.1

C.6.3.1.2. Retrofit Baseline Summary

For all retrofit projects, the baseline is the current federal efficacy standard. If the replacement system is a T8, then it must meet Consortium for Energy Efficiency (CEE) specification requirements for High Performance and Reduced Wattage T8 systems. Other high-performance systems, including but not limited to T5 and LED systems, are allowed. T12s are no longer an eligible baseline technology.

C.6.3.1.3. Federal Efficacy Standards

The Energy Independence and Security Act (EISA) of 2007 mandates minimum efficacy standards for general service incandescent lamps, modified spectrum general service incandescent lamps, incandescent reflector lamps, fluorescent lamps and metal halide lamps.

Effective January 1, 2010, EISA increased minimum ballast efficacy factors and established pulse-start metal halides (PSMHs) as the new industry standard baseline for the metal halide technology ($\leq$ 500 W). New construction projects must use PSMHs in metal halide applications.

Starting in 2012, baseline wattages for general service incandescent lamps (GSILs) should not exceed values specified by EISA. For convenience, Table 222 provides the lumens and wattages required to meet EISA standards for incandescent lamps.

Table 222: New Maximum Wattages for General Service Incandescent Lamps, 2012-2014

Old Standard Incandescent Wattage	***New Maximum Wattage (EISA 2007)***	***Rated Lumens***	***Effective Date[409]***
100	72	1490 - 2600	6/1/2012
75	53	1050 - 1489	6/1/2013
60	43	750 - 1049	6/1/2014
40	29	310 – 749	6/1/2014

The Energy Policy Act (EPAct) of 2005 and EISA of 2007 are two energy legislative rulings enacted to establish energy reduction targets for the United States. On July 14, 2009, the Department of Energy published a final rule for energy conservation standards for general service fluorescent lamps (GSFLs). These standards are shown in Table 223. As a result of this rule, all GSFLs manufactured in the United States, or imported for sale into the United States on or after July 14, 2012 (three years from the

[409] Adjusted from January to June assuming continued market availability for a period of 6 months after the standard effective date.

ruling date) must meet new, more stringent efficacy standards (measured in lumens per watt, LPW).

Table 223: Lighting Efficiency – Current Federal Efficiency Standards for GSFLs

Lamp Type	***Nominal Lamp Wattage***	***Minimum Color Rendering Index (CRI)***	***Minimum Average Lamp Efficacy (Lumens/Watt, or LPW)***
4-foot Medium Bi-Pin	> 35W ≤ 35 W	69 45	75.0 75.0
2-foot U-Shaped	> 35W ≤ 35W	69 45	68.0 64.0
8-foot Slimline	> 65W ≤ 65W	69 45	80.0 80.0
8-foot High Output	> 100W ≤ 100W	69 45	80.0 80.0

Facilities with 4-foot and 8-foot T12s or with 2-foot U-Shaped T12s are still eligible to participate in lighting retrofit projects, but an assumed electronic T8 baseline should be used in place of the existing T12 equipment. These T12 fixtures will remain in the standard wattage table with the label “T12 (T8 baseline)” and will include adjusted wattages assumptions consistent with a T8 fixture with an equivalent length and lamp count. T12 fixtures not specified above will remain an eligible baseline technology.

Table 224: Adjusted Baseline Wattages for T12 Equipment

T12 Length	***Lamp Count***	***Revised Lamp Wattage***	***Revised System Wattage***
48 inch-Std, HO, and VHO (4 feet)	1	32	31
	2	32	58
	3	32	85
	4	32	112
	6	32	170
	8	32	224
96 inch-Std (8 feet) 60/75W	1	59	69
	2	59	110
	3	59	179
	4	59	219
	6	59	330
	8	59	438*
96 inch-HO and VHO (8 feet) 95/110W	1	86	101
	2	86	160
	3	86	261
	4	86	319
	6	86	481
	8	86	638
2 ft. U-Tube	1	32	32
	2	32	60
	3	32	89
* 8 lamp fixture wattage approximated by doubling 4 lamp fixture wattage.			
Key: HO = high output, VHO = very high output			

C.6.3.1.4. Fixture Qualification Process – High Performance and Reduced Wattage T-8 Equipment:

CEE develops and maintains energy specifications for High Performance and Reduced Wattage T8 equipment. CEE high performance and reduced wattage T8 specifications can be found at:

1) http://www.cee1.org/com/com-lt/com-lt-specs.pdf (High Performance products)
2) http://www.cee1.org/com/com-lt/lw-spec.pdf (Reduced Wattage products)

CEE compiles a list of approved lamps and ballasts for T8 systems that are eligible for incentives for retrofits which is available for download on CEE's website at http://library.cee1.org/content/commercial-lighting-qualifying-products-lists.

C.6.3.1.5. Fixture Qualification Process – CFL and LED Products:

CFL and LED products must be pre-qualified under one of the following options:

1) Product is on the ENERGY STAR® Qualified Product List or ENERGY STAR® Qualified Light Fixtures Product List (http://www.energystar.gov)
2) Product is on the Northeast Energy Efficiency Partnerships (NEEP) DesignLights Consortium™ (DLC) Qualified Products Listing (www.designlights.org)
3) Exceptions to the ENERGY STAR® and/or DLC requirements are allowed for unlisted lamps and fixtures that have already been submitted to either ENERGY STAR® or DLC for approval. If the lamp or fixture does not achieve approval within the AR DSM program year, however, then the lamp or fixture must immediately be withdrawn from the program. If withdrawn, savings may be claimed up to the point of withdrawal from the program. For Agricultural uses where the fixture is designed for animal use, if an LED bulb does not meet ENERGY STAR® and/or DLC requirements, the bulb can be utilized if a thorough review of the bulb is conducted and verified by the program evaluator.

C.6.3.2. Input Wattages

Input wattages for pre-retrofit and qualifying fixtures are included in the Standard Fixture Wattage Table (Appendix E). This is a relatively comprehensive list of both old and new lighting technologies that could be expected for inclusion in a project. If there are fixtures identified that are not included in this table, those fixtures should be submitted to the Independent Evaluation Monitor (IEM) for review and incorporation into subsequent TRM updates. Interim approval may be made for certain fixtures at the discretion of the IEM. However, there may be eligible products that are not on the list. If a product is not on the list, then manufacturer's data should be reviewed prior to accepting the product into a program. LED products should be approved by DLC or ENERGY STAR® before being recognized as an eligible product.

C.6.3.3. Estimated Useful Life (EUL)

Table 225: Estimated Useful Life by Lamp Type

Lamp Type	***EUL (years)***	***Source***[410]
Halogen	2.0	Based upon 5,000-hour manufacturer rated life and weighted-average 3,380 annual operating hours from Navigant U.S. Lighting Study. Rated life values assume the use of energy-efficient Halogen Infrared (IR) products.
High Intensity Discharge (HID)	16.0	Based upon 50,000 hour manufacturer rated life and weighted-average 3,205 annual operating hours from Navigant U.S. Lighting Study.
Integrated-Ballast Cold-Cathode Fluorescent Lamps (CCFL)	5.0	Based upon 25,000 hour manufacturer rated life and weighted-average 5,493 annual operating hours from Navigant U.S. Lighting Study.
Integrated-Ballast Compact Fluorescent Lamps (CFL)	2.025	Based upon 8,000 hour manufacturer rated life and weighted-average 3,253 annual operating hours from Navigant U.S. Lighting Study.
Integrated-Ballast LED Lamps	9.0	Based on 30,000 hour manufacturer rated life and weighted-average 3,260 annual operating hours from Navigant U.S. Lighting Study.
Light Emitting Diode (LED)	15.0	Based upon 50,000 hour manufacturer rated life and weighted-average 3,260 annual operating hours from Navigant U.S. Lighting Study.
Linear Fluorescents (T5, T8)	16.0	Based upon 50,000 hour manufacturer rated life and weighted-average 3,211 annual operating hours from Navigant U.S. Lighting Study.
Modular CFL and CCFL	16.0	Based upon 60,000 hour manufacturer rated life and weighted-average 3,251 annual operating hours from Navigant U.S. Lighting Study.

[410] Navigant Consulting, "U.S. Lighting Market Characterization, Volume I: National Lighting Inventory and Energy Consumption Estimate, Final Report." U.S. DOE. September 2002.

C.6.3.4. Calculation of Deemed Savings

C.6.3.4.1. New Construction:

$$kW_{savings} = \left(\left(SF \times \frac{LPD}{1000}\right) - \sum\left(\left[N_{fixt(i)} \times \frac{W_{fixt(i)}}{1000}\right]_{post}\right)\right) \times CF \times IEF_D$$

$$kWh_{savings} = \left(\left(SF \times \frac{LPD}{1000}\right) - \sum\left(\left[N_{fixt(i)} \times \frac{W_{fixt(i)}}{1000}\right]_{post}\right)\right) \times AOH \times IEF_E$$

Where:

SF = Total affected square footage of the new construction facility

LPD = Maximum allowable power density by building type (W/ft^2) (Table F1-F4)

$N_{fixt(i),post}$ = Post-retrofit # of fixtures of type i

$W_{fixt(i),post}$ = Rated wattage of post-retrofit fixtures of type i (Appendix E)

CF = Peak demand coincidence factor (Table 227)

AOH = Annual operating hours for specified building type (Table 227)

IEF_D = Interactive effects factor for demand savings (Table 228)

IEF_E = Interactive effects factor for energy savings (Table 228)

C.6.3.4.2. Retrofit with no existing controls:

$$kW_{savings} = \sum\left(\left[N_{fixt(i)} \times \frac{W_{fixt(i)}}{1000}\right]_{pre} - \left[N_{fixt(i)} \times \frac{W_{fixt(i)}}{1000}\right]_{post}\right) \times CF \times IEF_D$$

$$kWh_{savings} = \sum\left(\left[N_{fixt(i)} \times \frac{W_{fixt(i)}}{1000}\right]_{pre} - \left[N_{fixt(i)} \times \frac{W_{fixt(i)}}{1000}\right]_{post}\right) \times AOH \times IEF_E$$

C.6.3.4.3. Retrofit with existing controls:

Note: For lighting systems with existing controls, no additional control savings should be claimed with the savings specified by the equations below.

$$kW_{savings} = \sum\left(\left[N_{fixt(i)} \times \frac{W_{fixt(i)}}{1000}\right]_{pre} - \left[N_{fixt(i)} \times \frac{W_{fixt(i)}}{1000}\right]_{post}\right) \times IEF_D \times CF_{controls}$$

$$kWh_{savings} = \sum\left(\left[N_{fixt(i)} \times \frac{W_{fixt(i)}}{1000}\right]_{pre} - \left[N_{fixt(i)} \times \frac{W_{fixt(i)}}{1000}\right]_{post}\right) \times IEF_E \times AOH \times PAF$$

Where:

$N_{fixt(i),pre}$ = Pre-retrofit number of fixtures of type i

$N_{fixt(i),post}$ = Post-retrofit number of fixtures of type i

$W_{fixt(i),pre}$ = Rated wattage of pre-retrofit fixtures of type i (Appendix E)

$W_{fixt(i),post}$ = Rated wattage of post-retrofit fixtures of type i (Appendix E)

CF = Peak demand coincidence factor (Table 227)

$CF_{controls}$ = Controls peak demand coincidence factor = 0.26[411]

AOH = Annual operating hours for specified building type (Table 227)

PAF = Power adjustment factor for specified control type (Table 220)

IEF_D = Interactive effects factor for demand savings (Table 228)

IEF_E = Interactive effects factor for energy savings (Table 228)

C.6.3.5. Operating Hours & Coincidence Factors (CF)

If the annual operating hours and/or CF for the specified building are not known, use the deemed average annual hours of operation and/or peak demand CF from Table 227.

Table 226 summarizes the general transferability ratings for the lighting end-use. Due to the low variability of schedules and weather for both indoor and outdoor lighting, there is a high degree of data transferability across regions and it is appropriate to assume very similar annual operating hours across different regions.[412] To the extent that utility system peak periods are similar, it is also appropriate to assume very similar peak CFs across different regions.

Table 226: Transferability of Data across Geographic Regions

Analysis Group	Schedule Variability	Weather Variability	Transferability Rating
Lighting – Exterior	Low	Low	High
Lighting – Interior	Low	Low	High

Operating hours are the number of hours that a particular equipment type is in use over the course of a year. For the purpose of these recommendations, raw building lighting operating hour data were adjusted by Frontier Associates according to the percentage of wattage consumed by each space within a building. Subsequently, weighted average operating hours (AOH) were developed for a range of building types.

[411] RLW Analytics, "*2005 Coincidence Factor Study,*" Connecticut Energy Conservation Management Board. January 4, 2007. Default value applicable to all building types. This coincidence factor is a combination of the savings factor and peak coincidence factor.

[412] KEMA. *End-Use Load Data Update Project Final Report: Phase 1: Cataloguing Available End-Use and Efficiency Measure Load Data*. 2009. Prepared for the Northwest Power and Conservation Council and Northeast Energy Efficiency Partnerships, November.

The CF for lighting is the ratio of the lighting kW demand during the utility's peak period (New Orleans does not have a specific peak period definition, and CF values are assumed to reflect peak loads of similar utilities) to the connected lighting kW ($\sum(N_i\ xW_i/$ 1000) as defined above. Other issues are automatically accounted for, such as diversity and load factor. A portion of the CF values were arrived at through secondary research. In the cases where acceptable values were not available through other sources, Frontier Associates calculated values comprised of CF and building operating hour data available for the types of building spaces that would likely be found within that building type.

Deemed annual operating hours from the Arkansas TRM 6.0 were used as a basis for New Orleans AOH. These hours were originally developed by Frontier Associates for the AR TRM. ADM used these values in conjunction with on-site monitoring from facility types commonly found New Orleans commercial lighting program participant populations. Direct monitoring data was collected from 210 loggers placed in 59 New Orleans and other major Louisiana utility territories. A total of (14) facility types received updated hours, and (10) new generic space types common in New Orleans area-projects were created:

Table 227: Annual Operating Hours (AOH) and Coincidence Factors (CF)[413]

Facility or Space Type	AOH	CF
Bar Area	2,676	0.81
Corridor/Hallway/Stairwell	5,233	0.90
Education: College/University	3,577	0.69
Education: K-12	2,333	0.47
Education: K-12 (specialized room)	2,676	0.47
Exterior	4,319	-
Food Prep (Generic)	5,543	0.81
Food Sales: 24-Hour Supermarket	6,900	0.95
Food Sales: Non-24-Hour Supermarket	2,058	0.95
Food Service: Fast Food	6,473	0.81
Food Service: Sit-Down Restaurant	4,731	0.81

[413] Unless otherwise noted, deemed AOH and CF values are based on Frontier Associates on behalf of Electric Utility Marketing Managers of Texas (EUMMOT). "Petition to Revise Existing Measurement & Verification Guidelines for Lighting Measures for Energy Efficiency Programs: Docket No. 39146." Public Utility Commission of Texas. Approved June 6, 2011. http://interchange.puc.state.tx.us/WebApp/Interchange/application/dbapps/filings/pgSearch.asp

Health Care: In-Patient	4,019	0.78
Health Care: Nursing Home	4,271	0.78
Health Care: Out-Patient	3,386	0.77
Kwik-E-Mart	4,245	0.90
Lodging (Hotel/Motel/Dorm): Common Areas	4,127	0.82
Lodging (Hotel/Motel/Dorm): Room	3,370	0.25
Manufacturing	5,740	0.73
Multi-family Housing: Common Areas	5,703	0.87
Non-Warehouse Storage (Generic)	4,207	0.77
Office	5,159	0.77
Office (attached to other facility)	4,728	0.77
Parking Structure	7,884	1.00
Public Assembly	2,638	0.56
Public Order and Safety	3,472	0.75
Religious Gathering	3,174	0.53
Restroom (Generic)	3,516	0.90
Retail: Enclosed Mall	4,813	0.93
Retail: Freestanding	3,515	0.90
Retail: Other	4,312	0.90
Retail: Strip Mall	3,965	0.90
Security Booth	4,389	0.75
Service: Excluding Food	3,406	0.90
Showroom Floor	4,057	0.90
Walk-In Cooler (Generic)	792	0.25
Warehouse: Non-Refrigerated	2,417	0.77
Warehouse: Refrigerated	3,798	0.84

C.6.3.6. Interactive Effects

Lighting in air conditioned and refrigerated spaces adds heat to the space, increasing the cooling requirement during the cooling season and decreasing the heating requirement during the heating season. The decrease in waste heat from lighting mitigates these effects, thus reducing electricity used for cooling and increasing electricity or gas used for heating.

Deemed interactive effects factors for both demand and energy savings are presented in Table 228. These factors represent the percentage increase or decrease in energy savings for the refrigeration system's electric load attributed to the heat dissipated by the more efficient lighting system. For example, a factor of 1.20 indicates a 20% savings. The methodology for applying these Interactive Effects Factors to calculate savings is discussed in the Calculation of Deemed Savings section.

A detailed description of the derivation of interactive effects is available in Appendix I.

Table 228: Commercial Conditioned and Refrigerated Space Interactive Effects Factors

Building Type	***Temperature Description***	***Heating Type***	IEF_D	IEF_E
All building types (Except Outdoor & Parking Structure)	Air Conditioned Space – Normal Temps. (> 41°F)	Gas	1.20	1.09
		Electric Resistance		0.87
		Heat Pump		1.02
		Heating Unknown [414]		0.98
	Refrigerated Space – Med. Temps. (33-41°F)	All	1.25	1.25
	Refrigerated Space – Low Temps. (-10-10°F)	All	1.30	1.30

C.6.3.7. Incremental Costs

Incremental costs by lighting category are as follows.

C.6.3.7.1. Commercial CFLs

Incremental costs are[415]:

- < 2,600 Lumens: $1.20
- Over 2,600 Lumens: $5

C.6.3.7.2. High Performance and Reduced Wattage T8s

Incremental costs are detailed in Table 229[416]:

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[414] These values should be used for programs where heat type cannot be determined.

[415] Illinois TRM

[416] Illinois TRM

Table 229: T8 Linear Fluorescent Incremental Costs

EE Measure	Watts	Baseline	Incremental Cost
4-lamp HPT8 High-bay	128	200W Pulse Start MH	$75
4-lamp HPT8 High-bay	128	250W Pulse Start MH	$75
6-lamp HPT8 High-bay	192	320W Pulse Start MH	$75
6-lamp HPT8 High-bay	192	400W Pulse Start MH	$75
8-lamp HPT8 High-bay	256	320W Pulse Start MH	$75
8-lamp HPT8 High-bay	256	400W Pulse Start MH	$75
1-lamp HPT8 – 32W	32	1-lamp standard F328- Electronic ballast	$15
1-lamp HPT8 – 28W	28	1-lamp standard F328- Electronic ballast	$15
1-lamp HPT8 – 25W	25	1-lamp standard F328- Electronic ballast	$15
2-lamp HPT8 – 32W	64	2-lamp standard F328- Electronic ballast	$18
2-lamp HPT8 – 28W	56	2-lamp standard F328- Electronic ballast	$18
2-lamp HPT8 – 25W	50	2-lamp standard F328- Electronic ballast	$18
3-lamp HPT8 – 32W	96	3-lamp standard F328- Electronic ballast	$20
3-lamp HPT8 – 28W	84	3-lamp standard F328- Electronic ballast	$20
3-lamp HPT8 – 25W	75	3-lamp standard F328- Electronic ballast	$20
4-lamp HPT8 – 32W	128	4-lamp standard F328- Electronic ballast	$23
4-lamp HPT8 – 28W	112	4-lamp standard F328- Electronic ballast	$23
4-lamp HPT8 – 25W	100	4-lamp standard F328- Electronic ballast	$23
2-lamp HPT8 Troffer	64	3-lamp standard F328- Electronic ballast	$100
RW T8-F28 Lamp	28	F32 T8 Standard lamp	$2
RW T8-F28 Extra Life Lamp	28	F32 T8 Standard lamp	$2
RW T8-F32/25W Lamp	25	F32 T8 Standard lamp	$2
RW T8-F32/25 Extra Life Lamp	285	F32 T8 Standard lamp	$2
RWT8 F17T8 Lamp - 2 ft.	16	F17 T8 Standard lamp – 2 ft.	$2
RWT8 F25T8 Lamp - 3 ft.	23	F25 T8 Standard lamp – 3 ft.	$2
RWT8 F30T8 Lamp - 6' Utube	30	F32 T8 Standard Utube	$2
RWT8 F29T8 Lamp - Utube	29	F32 T8 Standard Utube	$2
RWT8 F96T8 Lamp - 8 ft.	65	F96 T8 Standard lamp – 8 ft.	$2

C.6.3.7.3. T5 Linear Fluorescent Fixtures

Table 230: T5 Linear Fluorescent Incremental Costs

EE Measure	Watts	Baseline	Incremental Cost
2-lamp T5 High-bay	180	200W Pulse Start MH	$100
3-lamp T5 High-bay	180	200W Pulse Start MH	$100
4-lamp T5 High-bay	240	320W Pulse Start MH	$100
6- lamp T5 High-bay	192	320W Pulse Start MH	$100
1-lamp T5 Troffer	32	3-lamp T8	$40
2-lamp T5 Troffer	64	3-lamp T8	$80
1-lamp T5 Industrial/Strip	32	3-lamp T8	$30
2- lamp T5 Industrial/Strip	64	3-lamp T8	$60
3- lamp T5 Industrial/Strip	96	3-lamp T8	$90
4- lamp T5 Industrial/Strip	187	3-lamp T8	$120
1-lamp T5 Indirect	32	3-lamp T8	$30
2-lamp T5 Indirect	64	3-lamp T8	$60

C.6.3.7.4. LEDs

Table 231: Omnidirectional LED Incremental Costs

LED Measure Description	LED Lamp Cost	Baseline Cost (EISA 2012-2014, EISA 2020)	Incremental Cost (EISA 2012-2014, EISA 2020)
LED Screw and Pin-based Bulbs, Omnidirectional, <10W	$30.00	$0.34 ($1.25, $2.50)	$29.66 ($28.75, $27.50)
LED Screw and Pin-based Bulbs, Omnidirectional, >=10W	$40.00	$0.34 ($1.25, $2.50)	$39.66 ($38.75, $37.50)
LED Screw and Pin-based Bulbs, Decorative	$30.00	$1.00	$29.00

Table 232: LED Incremental Costs[417]

LED Category	EE Measure	Incremental Cost
LED Downlight Fixtures	LED Recessed, Surface, Pendant Downlights	$27
LED Interior Directional	LED Track Lighting	$59
	LED Wall-Wash Fixtures	$59
LED Display Case	LED Display Case Light Fixture	$11/ft.
	LED Undercabinet Shelf-Mounted Task Light Fixtures	$11/ft.
	LED Refrigerated/Freezer Case light	$11/ft.
LED Linear Replacement Lamps	LED 4' Linear Replacement Lamp	$13
	LED 2' Linear Replacement Lamp	$13
LED Troffers	LED 2x2 Recessed Light Fixture, 2,000-3,500 Lumens	$48
	LED 2x2 Recessed Light Fixture, 3,501-5,000 Lumens	$91
	LED 2x4 Recessed Light Fixture, 3,000-4,500 Lumens	$62
	LED 2x4 Recessed Light Fixture, 4,501-6,000 Lumens	$99
	LED 2x4 Recessed Light Fixture, 6,001-7,500 Lumens	$150
	LED 1x4 Recessed Light Fixture, 3,001-4,500 Lumens	$36
	LED 1x4 Recessed Light Fixture, 4,401-6,000 Lumens	$130
LED Linear Ambient Fixtures	LED Surface & Suspended Linear Fixture, <=3,000 Lumens	$54
	LED Surface & Suspended Linear Fixture, 3,001-4,500 Lumens	$104
	LED Surface & Suspended Linear Fixture, 4,501-6,000 Lumens	$158
	LED Surface & Suspended Linear Fixture, 6,001-7,500 Lumens	$215
	LED Surface & Suspended Linear Fixture, >7,500 Lumens	$374
LED Low Bay & High Bay Fixtures	LED Low-Bay Fixtures, <= 10,000 Lumens	$191
	LED High-Bay Fixtures, 10,001-15,000 Lumens	$331
	LED High-Bay Fixtures, 15,001-20,000 Lumens	$482
	LED High-Bay Fixtures, > 20,000 Lumens	$818

[417] Watt, lumen, lamp life, and ballast factor assumptions for efficient measures are based upon Consortium for Energy Efficiency (CEE) Commercial Lighting Qualifying Product Lists alongside past Efficiency Vermont projects and PGE refrigerated case study. Watt, lumen, lamp life, and ballast factor assumptions for baseline fixtures are based upon manufacturer specification sheets. Baseline cost data comes from lighting suppliers, past Efficiency Vermont projects, and professional judgment. Efficient cost data comes from 2012 DOE "Energy Savings Potential of Solid-State Lighting in General Illumination Applications", Table A.1. See "LED Lighting Systems TRM Reference Tables.xlsx" for more information and specific product links.

LED Agricultural Interior Fixtures	LED Ag Interior Fixtures, <= 2,000 Lumens	$33
	LED Ag Interior Fixtures, 2,001-4,000 Lumens	$54
	LED Ag Interior Fixtures, 4,001-6,000 Lumens	$125
	LED Ag Interior Fixtures, 6,001-8,000 Lumens	$190
	LED Ag Interior Fixtures, 8,001-12,000 Lumens	$298
	LED Ag Interior Fixtures, 12,001-16,000 Lumens	$450
	LED Ag Interior Fixtures, 16,001-20,000 Lumens	$595
	LED Ag Interior Fixtures, > ,000 Lumens	$998
LED Exterior Fixtures	LED Exterior Fixtures, <=5,000 Lumens	$190
	LED Exterior Fixtures, 5,001-10,000 Lumens	$287
	LED Exterior Fixtures, 10,001-15,000 Lumens	$391
	LED Exterior Fixtures, > 15,000 Lumens	$793

C.6.3.8. Future Studies

This measure category constitutes over 90% of C&I savings historically in Energy Smart. As a result, this category should be a primary focus of EM&V research. ADM recommends the following:

- Conduct metering studies for commercial facilities not captured in EM&V to-date.
- Conduct a cost study to update incremental costs to reflect New Orleans prices, sales tax rates, and labor costs.
- Conduct focused metering for lighting that is not listed in Energy Start or CEE lists.
- Conduct a market assessment for advanced lighting controls; mature lighting programs have begun further incorporation of Wi-Fi-enabled control schemes where lighting is incorporated into the Energy Management System (EMS). ADM recommends a market assessment for advanced lighting control adoption in New Orleans.
- Conduct preliminary research to assess whether certain lighting categories would be better-served with a midstream program approach.

C.7.1. Plug Load Occupancy Sensors

C.7.1.1. Measure Description

Plug load occupancy sensors are devices that control low wattage devices (<150 watts) using an occupancy sensor. Common applications are computer monitors, desk lamps, printers, and other desktop equipment. Three wattage tiers were analyzed based on available products in the market: 25W, 50W, and 150W.

C.7.1.2. Baseline and Efficiency Standards

Table 233: Plug Load Without Occupancy Sensors– Baseline Data

Size (watts)	Annual Energy Consumption[418] (kWh/ unit)	Annual Operating Hours	Demand (kW/unit)
25	110	4,400	0.025
50	220	4,400	0.05
150	555	3,700	0.15

Table 234 contains the annual energy consumption and demand for plug load occupancy sensors.

Table 234: Plug Load Occupancy Sensors – Minimum Requirements

Size (watts)	Annual Energy Consumption[419] (kWh/ unit)	Annual Operating Hours	Demand[1] (kW/ unit)
25	45	1452	0.025
50	91	1452	0.050
150	234	1250	0.150

C.7.1.3. Estimated Useful Life (EUL)

According to DEER 2014, the estimated useful life (EUL) is eight years.

[418] Arkansas TRM

[419] Ibid.

C.7.1.4. Deemed Savings Values

Deemed measure costs and savings for various sized plug load occupancy sensors are provided in *Table 235*.

Table 235: Plug Load Occupancy Sensors – Deemed Savings Values

Measure	***Demand Savings[1] (kW/ unit)***	***Annual Energy Savings[1] (kWh/ unit)***
25W sensor	0.000	65
50W sensor	0.000	129
150W sensor	0.000	321

C.7.1.5. Calculation of Deemed Savings

Four resources contained information on plug load occupancy sensors. The energy savings and amount of equipment controlled per sensor varied widely. The values for energy and demand savings are given in Table 236.

Table 236: Review of Plug Load Occupancy Sensor Measure Information

Available Resource	***Type***	***Size***	***Annual Energy Saving (kWh/unit)***	***Demand Savings (kW/unit)***
PG&E 2003	Plug load occupancy sensor	150	300	0.124
Quantec 2005	Power strip occupancy sensor	N/A	27	0.012
DEER 2005	Plug load occupancy sensor	50	143	0.051
KEMA 2010	Plug load occupancy sensor	50	221	0.025
NPCC 2005	Cubicle occupancy sensor	25	55	0.025
PacifiCorp 2009	Unitary savings included in comprehensive potential study		196	0.00

C.7.1.6. Incremental Cost

The incremental cost is $70.[420]

C.7.1.1. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. If this measure is added to Energy Smart programs, the evaluation should include a field assessment to inventory the plug loads actually controlled.

420 Ohio TRM.

C.7.2. Advanced Power Strips

C.7.2.1. Measure Description

This measure involves the installation of a multi-plug Advanced Power Strip (APS) that has the ability to automatically disconnect specific loads depending on the power draw of a specified or "master" load. A load sensor in the strip disconnects power from the control outlets when the master power draw is below a certain threshold. The energy savings calculated for this measure are derived by estimating the number of hours that devices in typical office workstations are in "off" or "standby" mode and the number of watts consumed by each device in each mode. When the master device (i.e. computer) is turned off, power supply is cut to other related equipment (i.e. monitors, printers, speakers, etc.), eliminating these loads.

Commercial deemed savings were developed based on reported plug load electricity consumption. The assumed mix of peripheral electronics, and related data, are presented in the following table.

Table 237 shows the assumed number of hours each device is typically in "off" mode. Given the assumption that the master device, a desktop computer, will only be in off mode during non-work hours, watts consumed by devices in standby-mode are not counted toward energy savings for a commercial APS. Workday and weekend day watts consumed in off mode are a function of hours multiplied by estimated watt consumption.

There are two deemed savings paths available: Savings can be estimated as follows: 1) per APS for an average complete system or 2) by individual peripheral device.

Table 237: Peripheral Watt Consumption Breakdown

Peripheral Device	Workday Daily Off Hours[421]	Weekend Daily Off Hours	Off Power (W)[422,423]	Workday (W-hr) [A]	Weekend (W-hr) [B]
Coffee Maker	16	24	1.14	18.24	27.36
Computer: Desktop	16	24	3.3	52.80	79.20
Computer: Laptop	16	24	4.4	70.40	105.60
Computer Monitor: CRT	16	24	1.5	24.00	36.00
Computer Monitor: LCD	16	24	1.1	17.60	26.40
Computer Speakers	16	24	2.3	36.80	55.20
Copier	16	24	1.5	24.00	36.00

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[421] Commercial hours of operation based on typical 8-hour workday schedule.

[422] New York State Energy Research and Development Authority (NYSERDA), "Advanced Power Strip Research Report". August 2011.

[423] Standby Power Summary Table, Lawrence Berkeley National Laboratory. http://standby.lbl.gov/summary-table.html.

External Hard Drive	16	24	3.0	48.00	72.00
Fax Machine: Inkjet	16	24	5.3	84.80	127.20
Fax Machine: Laser	16	24	2.2	35.20	52.80
Media Player: Blu-Ray	16	24	0.1	1.60	2.40
Media Player: DVD	16	24	2.0	32.00	48.00
Media Player: DVD-R	16	24	3.0	48.00	72.00
Media Player: DVD/VCR	16	24	4.0	64.00	96.00
Media Player: VCR	16	24	3.0	48.00	72.00
Microwave	16	24	3.08	49.28	73.92
Modem: Cable	0	24	3.8	0.00	91.20
Modem: DSL	0	24	1.4	0.00	33.60
Multi-Function Printer: Inkjet	16	24	5.26	84.16	126.24
Multi-Function Printer: Laser	16	24	3.12	49.92	74.88
Phone with Voicemail	16	24	2.92	46.72	70.08
Printer: Inkjet	16	24	1.3	20.80	31.20
Printer: Laser	16	24	3.3	52.80	79.20
Router	16	24	1.7	27.20	40.80
Scanner	16	24	2.1	33.60	50.40
Television: CRT	16	24	1.6	25.60	38.40
Television: LCD	16	24	0.5	8.00	12.00
Television: Plasma	16	24	0.6	9.60	14.40
Television: Projection	16	24	7.0	112.00	168.00

C.7.2.2. Baseline and Efficiency Standards

The baseline case is the absence of an APS, where peripherals are plugged into a traditional surge protector or wall outlet. The baseline assumes a typical mix of office equipment, shown in Table 237

C.7.2.3. Estimated Useful Life (EUL)

The estimated useful life (EUL) is 10 years according to the New York State Energy Research and Development Authority (NYSERDA) Advanced Power Strip Research Report from August 2011.[424]

[424] New York State Energy Research and Development Authority (NYSERDA): Advanced Power Strip Research Report, p. 30. August 2011.

C.7.2.4. Calculation of Deemed Savings

C.7.2.4.1. Energy Savings

Energy savings for a 7-plug APS in use in a commercial setting are calculated using the following algorithm, where kWh saved are calculated and summed for all peripheral devices:

$$\Delta kWh = \frac{\sum(Workdays * A_i) + \sum((365 - Workdays) * B_i)}{1,000}$$

Where:

Workdays = Average number of workdays per year[425] = 240 days

A = Watt-hours/day consumed in the "off" mode per workday

B = Watt-hours/day consumed in the "off" mode per weekend day

1,000 = Constant to convert watts to kilowatts

C.7.2.4.2. Demand Savings

No demand savings are awarded for this measure due to the assumption that typical office equipment will be operating throughout the workday.

C.7.2.5. Deemed Savings Values

Energy savings from an APS in an office setting are estimated to be 71.4 kWh using the above equation and assuming six unique peripheral devices. Energy savings per peripheral device are also available in the following table.

Table 238: Advanced Power Strips – Deemed Savings Values

Peripheral Device	***kWh Savings***
Coffee Maker	7.8
Computer: Desktop	22.6
Computer: Laptop	30.1
Computer Monitor: CRT	10.3
Computer Monitor: LCD	7.5
Computer Speakers	15.7
Copier	10.3
External Hard Drive	20.5
Fax Machine: Inkjet	36.3
Fax Machine: Laser	15.0

[425] Assuming 50 working weeks, deducting 2 weeks for federal holidays and another 2 weeks for vacation; 48 weeks x 5 days/week = 240 days

Media Player: Blu-Ray	0.7
Media Player: DVD	13.7
Media Player: DVD-R	20.5
Media Player: DVD/VCR	27.4
Media Player: VCR	20.5
Microwave	21.1
Modem: Cable	11.4
Modem: DSL	4.2
Multi-Function Printer: Inkjet	36.0
Multi-Function Printer: Laser	21.3
Phone with Voicemail	20.0
Printer: Inkjet	8.9
Printer: Laser	22.6
Router	11.6
Scanner	14.4
Television: CRT	10.9
Television: LCD	3.4
Television: Plasma	4.1
Television: Projection	47.9
Average APS: Small Business Whole System[426]	**61.2**

C.7.2.6. Incremental Cost

The incremental cost is $16 for a 5-plut and $26 for a 7-plug strip[427].

C.7.2.1. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. If this measure is added to Energy Smart programs, the evaluation should include a field assessment to inventory the plug loads actually controlled.

[426] Assuming Computer Monitor: LCD, Computer Speakers, Modem: Average, Printer: Average, and Scanner. Computer not included because it is assumed to be the controlling load. This average value is meant to apply to a typical small business application and should not be applied in other applications. For other applications, calculate the savings for each individual equipment type. kWh savings = 7.5 + 15.7 + [(11.4 + 4.2) ÷ 2] + [(8.9 + 22.6) ÷ 2] + 14.4 = 61.2 kWh.

[427] Price survey performed in NYSERDA Measure Characterization for Advanced Power Strips, p4

C.7.3. Computer Power Management

C.7.3.1. Measure Description

Computer Power Management (CPM) is the automated control of the power, or “sleep” settings of network desktop and notebook computer equipment. CPM involves using built-in features or add-on software programs to switch off displays and enable computers to enter a low power setting called sleep mode during periods of non-use. This measure applies to both ENERGY STAR® and conventional computer equipment, and assumes that the same computer equipment is being used before and after CPM settings are activated. The power draw of a computer is assumed to be roughly equivalent during active and idle periods, so for the purposes of calculating savings, we will combine the terms active and idle as “active/idle” throughout the document.

C.7.3.2. Baseline and Efficiency Standards

The baseline conditions are the estimated number of hours that the computer spends in idle and sleep mode before the power settings are actively managed. The efficient conditions are the estimated number of hours that the computer spends in active/idle and sleep mode after the power settings are actively managed. Operating hours may be estimated from metering, or the default hours provided in the calculation of deemed savings may be used.

C.7.3.3. Calculation of Deemed Savings

Deemed demand and annual savings are based on the ENERGY STAR® Low Carbon IT Savings calculator. The coincidence factor, default equipment wattages in Table 239, and the active/idle and sleep hours are taken from assumptions in the ENERGY STAR® calculator with all equipment set to enter sleep mode after 15 minutes of inactivity.

$$kWh_{savings} = \frac{W_{active/idle}\left(hours_{active/idle_{pre}} - hours_{active/idle_{post}}\right) + W_{sleep}\left(hours_{sleep_{pre}} - hours_{sleep_{post}}\right)}{1{,}000}$$

$$kW_{savings} = \frac{(W_{active/idle} - W_{sleep}) * CF}{1{,}000}$$

Where:

$W_{active/idle}$ = total wattage of the equipment, including computer and monitor, in active/idle mode; see Table 239

$Hours_{active\_idle\_pre}$ = annual number of hours the computer is in active/idle mode before computer management software is installed = 6,293

$Hours_{active\_idle\_post}$ = annual number of hours the computer is in active/idle mode after computer management software is installed = 1,173

W_{sleep}= total wattage of the equipment, including computer and monitor, in sleep mode; see Table 239

$Hours_{sleep\_pre}$= annual number of hours the computer is in sleep mode before computer management software is installed = 0

$Hours_{sleep\_post}$ = annual number of hours the computer is in sleep mode after computer management software is installed = 5,120

CF= Coincidence Factor[428] = 0.25

1,000 = W/kW conversion

Table 239: Computer Power Management - Equipment Wattages

Equipment	W_{sleep}	$W_{active/idle}$
Conventional LCD Monitor	1	32
Conventional Computer	3	69
Conventional Notebook (including display)	2	21

Table 240: Computer Power Management - Deemed Savings Values

Equipment	***kWh savings***	***kW savings***
Conventional LCD Monitor	158.72	0.008
Conventional Computer	337.92	0.017
Conventional Notebook (including display)	97.28	0.005

C.7.3.4. Estimated Useful Life (EUL)

The EUL of this measure is based on the useful life of the computer equipment which is being controlled. Computer technology may continue to function long after technological

[428] The coincidence factor is the percentage of time the computer is assumed to be not in use during the hours 3pm to 6pm from the ENERGY STAR® calculator modeling study.

advances have diminished the usefulness of the equipment. The EUL for Computer Power Management is 4 years.[429]

C.7.3.5. Incremental Cost

The incremental cost is $29 per computer, including labor.[430]

C.7.3.1. Future Studies

At the time of authorship of the New Orleans TRM Version 1.0, this measure was not implemented in Energy Smart programs. If this measure is added to Energy Smart programs, the evaluation should include a field assessment to inventory the plug loads actually controlled.

[429] The Regional Technical Forum, Measure workbook for Commercial: Non-Res Network Computer Power Management. http://rtf.nwcouncil.org/measures/measure.asp?id=95. Accessed August 2013.

[430] Work Paper WPSCNROE0003 Revision 1, Power Management Software for Networked Computers. Southern California Edison

Appendix: Inputs

Residential

ENERGY STAR© Appliances

Unless otherwise noted, deemed savings values and inputs were derived form and found in the Energy Star calculators: https://www.energystar.gov/products/appliances.

Domestic Hot Water

Ambient Water Main (Tin) and Ambient Air Temperature (Tamb) Calculations based on New Orleans City Climate

Ambient Water Main (Tin) and Outside Air Temperature (Tamb) Calculations based on TMY3 New Orleans climate data

New Orleans	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual Avg*
Month	1	2	3	4	5	6	7	8	9	10	11	12	
Outside Air Temperature (T_{air})	49.9	55.6	64.1	69.4	75.1	80.7	81.6	82.3	77.7	68.2	65.6	54.5	68.7
Water Heater Inlet Water Temperature, (T_{in})	66.0	64.2	65.2	68.6	73.6	78.9	83.1	85.2	84.4	81.2	76.3	70.9	74.8
offset (district water) =	6.00												
ratio =	0.647												
lag =	34.8												

Estimated Hot Water Usage (By Tank Size)

The values in Table 25 are based off Table 136: Estimated Annual Hot Water Use (gal), Arkansas TRM 5.0, page 137.

Tanks Size (gal) of Replaced Water Heater	*40*	*50*	*65*	*80*
El Dorado Estimated Annual Hot Water Use (gal)	17,815	20,245	24,293	29,152

ADM created a correction factor to compensate for the difference in the average water main temperatures between the two cities.

$$\textit{Correction Factor} = \frac{\textit{El Dorado Average Water Main Temperature}}{\textit{New Orleans Average Water Main Temperature}} = \frac{\mathbf{70.1}}{\mathbf{74.8}}$$
$$= \mathbf{.937166}$$

The correction factor was applied to existing El Dorado hot water usage estimates resulting on values appropriate for New Orleans:

Tanks Size (gal) of Replaced Water Heater	***40***	***50***	***65***	***80***
New Orleans Estimated Annual Hot Water Use (gal)	16,696	18,973	22,767	27,320

Estimated Average Ambient Temperatures by Water Heater Installation Location

Average ambient air temperature, New Orleans (TMY3)	68.78
Number of heating degree days, New Orleans (TMY3, base 65)	126
Number of cooling degree days, New Orleans (TMY3, base 65)	239
Ratio of conditioned/unconditioned	1.00549

Heat Pump Water Heater Adjustment Factor

	Count	***% of year***
Heating Days	126	35%
Cooling Days	239	65%

PA% for conditioned space: 2.784%

	COP-Heating	***COP-Cooling***	***Calculated F Adj***	***Calculated Adj***	***Estimated Adj***
Gas	20	3	1.201	0.856	0.917
Heat Pump	2	3	1.046	0.983	1.201
Elec.Resistance	0.89	3	0.830	1.238	1.395

Water Heater Jackets Deemed Savings Values

Estimated hot water usage (by tank size) Deemed water heating jacket savings are Table 143: Water Heater Jackets – Electric Heating Deemed Savings Values Arkansas TRM 5.0, page 144.

Annual Average Daily Isolation

Daily Total Insolation (BTU/ft2/day) (AR TRM 5.0)	1,601
Average solar radiation El Dorado, AR (NREL)	1,407
Average solar radiation New Orleans, LA (NREL)	1,405
Correction factor	1.137
New Orleans Solar radiation x Correction Factor =	1,598

Weather Zone Localization Factor for SEF

Average solar radiation New Orleans, LA (NREL): 4.33 kWh/m2/day = 1,405.254 BTU/ft2/day

Average solar radiation El Dorado, AR (AR TRM 5.0): 1,601 BTU/ft2/day

Latitude correction factor: 1.137

Envelope

Appendix A: Prototype Building Characteristics

Various building energy usage computer models have been used in development of deemed savings included in the TRM according to several factors:

- Building Type and Use. Prototype buildings support deemed savings development for measures to be implemented in the following building types: residential, converted residence (CR), commercial, and small commercial (SC).
- Model Vintage. Original prototypes date back to deemed savings developed in 2007/08 for use in the QuickStart programs. Prototype inputs have been updated for more recent models.
- Measure being modeled. Specific changes to a prototype are introduced to represent the specific measure being implemented in a given building.

In this Appendix, “top level” tables – those tables with the letter A followed only by a number in their table name (e.g. Table A1) provide the general characteristics of a given model prototype. “Supplemental tables” – (e.g. Table A1.a) – provide the specific changes introduced to a given prototype for the modeling of specific measures.

The following table applies to the Attic Knee Wall Insulation, Ceiling Insulation, Wall Insulation, Floor Insulation, Roof Deck Insulation, Air Infiltration, Radiant Barriers, ENERGY STAR® Windows, and Window Film measures. Unique modifications for each specific measure are listed in supplemental Tables A3.a through A3.h. BEopt™ – a residential building modeling platform developed by NREL – was used to estimate energy savings for these measures using the U.S. DOE EnergyPlus simulation engine.

Residential Envelope Measures – Prototype Home Characteristics

Shell Characteristic	Value	Source(s)
Site/Layout		
Conditioned Floor Area	1,764ft^2	Average square footage of conditioned (heated) space between one story home and all SFD homes in 2009 RECS microdata for AR/LA/OK.[431]
Orientation	Square building with faces on each cardinal direction	LBNL: Nationally Representative Housing Sample[432]
Number of Stories	Single story with unfinished attic	Preponderance of SFD homes in 2009 RECS microdata are single story
Building Envelope		
Foundation	Slab-on-ground, no edge insulation	Preponderance of SFD homes in 2009 RECS microdata (62%) have slab foundation Also a conservative assumption for base energy usage.
Slab Insulation	None – no perimeter, under-slab, or above-slab insulation	Not part of standard practice, also no requirement for slab insulation in residential code for relevant weather regions except the NW corner of state in IECC Climate Zone 4.
Ceiling Insulation	R-12	Table 25 of BA Home Simulation Protocols suggests R-9 is appropriate for homes closed rafter roofs built with 2 x 6 beams, R-15 for 2 x 10. Suspect 2 x 6 is more likely, but some share of homes will have had ceiling insulation replaced/added. Select R-12 based

[431] 2009 RECS, Available at: http://www.eia.gov/consumption/residential/data/2009/

[432] Simulating a Nationally Representative Housing Sample Using EnergyPlus, Available at: http://www.osti.gov/scitech/servlets/purl/1012239

		on the above information and engineering judgment.[433]
Wall Insulation	R-11	BAHSP, p. 35 – value for homes built 1980-1989
Air Leakage	0.9 ACH	Median ACH for older, low income housing.[434]
Fenestration		
Window Area	15% opf wall area	American Housing Survey 2007 and 2008 was used to inform the value for likely participants.
Window U-value	0.81	2009 ASHRAE Fundamentals, Ch. 15 Table 4. Value for double-pane, metal frame, fixed, clear glass window.
Window SHGC	0.64	2009 ASHRAE Fundamentals, Ch. 15 Table 10. Value for double-pane, metal frame, fixed, clear glass window.
HVAC		
Efficiency Rating, Air Conditioner	10 SEER	Federal Standard in effect from 1990-2006. Representative of low-efficiency program participant homes.
Efficiency Rating Space Heating (Gas Furnace)	78% AFUE	Annual Fuel Utilization Efficiency – base gas furnace efficiency
Efficiency Rating Space Heating (Electric Resistance Heat)	COP 1.0	Coefficient of Performance for central electric resistance heating systems
Efficiency Rating Space Heating (Heat Pump)	HSPF = 7.25	Average of Federal Standards: 1992 – 1/2006: 6.8 HSPF 1/2006 – 1/2015: 7.7 HSPF
Thermostat Settings	Heating: 71 F Cooling 76 F	BAHSP, p. 49
Duct Losses	20%	Lower tier of air leakage for typical homes as cited by ENERGY

[433] Building America Home Simulation Protocols (BAHSP), Available at: http://www.nrel.gov/docs/fy11osti/49246.pdf

[434] Referenced information is from 2009 ASHRAE Fundamentals, Section 16.17 Residential Ventilation.

		STAR®[435]
Duct Insulation	R-4	
Domestic Hot Water		
Energy Factor, Electric Storage	0.9	BAHSP (p. 42) EWH with 50 gal tank, 3-inch insulation.
Energy Factor, Gas Storage	0.59	BAHSP (p. 42), midpoint between options 2 and 3
Lighting		
Share of Lighting by Type	Lamps are 66% incandescent, 21% CFL, 13% T-8 linear fluorescent	BAHSP (p. 16)

Shell Characteristic	Value	Source(s)
Ceiling Construction	2 foot wide vaulted ceiling around the perimeter of the conditioned floor area	This modeling approach reduces simulation distortions introduced by a large vaulted ceiling area, while still exposing the attic knee walls to the conditioned living space.
Base Knee Wall Insulation	No existing insulation	Encountered insulation level drives eligibility for this measure
Improved Knee Wall Insulation	(1) Insulate to R-19, or (2) Insulate to R-30	Efficiency Measure

Ceiling Insulation – Prototype Home Characteristics

Shell Characteristic	Value	Source(s)
Base Ceiling Insulation	Five ranges of encountered ceiling insulation: R-0 to R-1 R-2 to R-4 R-5 to R-8 R-9 to R-14 R-15 to R-22	Insulation level as encountered by the EESP drives eligibility for this measure
Improved Ceiling Insulation	Insulate to R-38 & R-49	Efficiency measure – retrofit insulation level

Wall Insulation – Prototype Home Characteristics

435 ENERGY STAR®, Duct Sealing: http://www.energystar.gov/?c=home_improvement.hm_improvement_ducts

Shell Characteristic	Value	Source(s)
Base Wall Insulation	R-0	Insulation level as encountered by the EESP drives eligibility for this measure
Improved Wall Insulation	R-13 & R-23	3.5" of fiberglass batt at R-3.7/in provides R-13 Full thickness of 4" cavity with open cell foam provides R-13 Full thickness of 4" cavity with open cell foam provides R-13

Floor Insulation – Prototype Home Characteristics

Shell Characteristic	Value	Source(s)
Foundation	Pier and beam with vented crawlspace	Floor Insulation not a relevant measure for homes with slab foundation
Base Floor Insulation	R-0	Insulation level as encountered by the EESP drives eligibility for this measure
Change Floor Insulation	R-19	This brings existing homes in compliance with IECC 2009.
Crawlspace Insulation	R-13	This brings existing homes in compliance with IECC 2009.

Air Infiltration – Prototype Home Characteristics

Shell Characteristic	Value	Source(s)
Base Air Leakage	0.9 ACH	Median infiltration value of older low-income housing sample:
Change Air Leakage	.035 ACH	Minimum allowable air exchanges assuming a 1,764 ft2 and 3 bedroom prototype home: ASHRAE 62.2 P - 2010

Radiant Barriers – Prototype Home Characteristics

Shell Characteristic	Value	Source(s)

Ceiling Insulation Case 1	≤ R-19	Assumed existing insulation level
Ceiling Insulation Case 2	> R-19	Assumed existing insulation level
Base roof deck	No radiant barrier	Existing condition applicable for this measure
Change roof deck	Double-Sided, Foil: Installed radiant barrier meeting ENERGY STAR® standards	Efficiency Measure

Window Film – Prototype Home Characteristics

Shell Characteristic	Value	Source(s)
Baseline Window Characteristics – double-pane model	0.81 U-value/0.64 SHGC	U-value assuming metal framed, double-pane clear glass windows 2009 ASHRAE Fundamentals, Ch.15 Tables 4 and 10
Baseline Window Characteristics – single-pane model	1.12 U-value/0.79 SHGC	U-value assuming metal framed, single-pane clear glass windows 2009 ASHRAE Fundamentals, Ch.15 Tables 4 and 10
Change Case Window Characteristics – double-pane model	0.81 U-value/0.49 SHGC	Efficiency Measure – values based on 3M product performance and technical data
Change Case Window Characteristics – single-pane model	1.12 U-value/0.40 SHGC	Efficiency Measure – values based on 3M product performance and technical data

Ambient Water Main (Tin) and Ambient Air Temperature (T_{amb}) Calculations based on New Orleans City Climate

Ambient Water Main (Tin) and Outside Air Temperature (T_{amb}) Calculations based on TMY3 New Orleans climate data

New Orleans	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***	***Annual Avg***
Month	1	2	3	4	5	6	7	8	9	10	11	12	
Outside Air Temperature (T_{air})	49.9	55.6	64.1	69.4	75.1	80.7	81.6	82.3	77.7	68.2	65.6	54.5	68.7
Water Heater Inlet Water Temperature, (T_{in})	66.0	64.2	65.2	68.6	73.6	78.9	83.1	85.2	84.4	81.2	76.3	70.9	74.8
offset (district water) =	6.00												
ratio =	0.647												
lag =	34.8												

Duct Efficiency Improvements, Duct Insulation (SC), Cool Roofs, & Window Awnings (SC) – Prototype Building Characteristics

Building Characteristic	Building Type		
	Small Office	Stand-Alone Retail	Strip Mall
General			
Ground Area (Sq. Ft.)	7,500	15,000	7,500
# of Stories	2	1	1
Floor Area (Sq. Ft.)	15,000	15,000	7,500
Roof			
Construction	Metal Frame, > 24 in. o.c.	Metal Frame, > 24 in. o.c.	Metal Frame, > 24 in. o.c.
Ext. Finish	Roof, Built up	Roof, Built up	Roof, Built up
Ext. Color	Med (abs = 0.6)	Med (abs = 0.6)	Med (abs = 0.6)
Ext. Insulation	Varied	Varied	Varied
Add'l Insulation	No batt or radiant barrier	No batt or radiant barrier	No batt or radiant barrier
Walls			
Construction	Metal Frame, 2x6, 24 in. o.c.	Metal Frame, 2x6, 16 in. o.c.	Metal Frame, 2x4, 16 in. o.c.
Ext. Finish	Wood/Plywood	CMU	Stucco/Gunite
Ext. Color	Med (abs = 0.6)	Med (abs = 0.6)	Med (abs = 0.6)
Ext. Insulation	3/4 in. fiber bd sheathing (R-2)	3/4 in. fiber bd sheathing (R-2)	1/2 in. fiber bd sheathing (R-1.3)

Building Characteristic	Building Type		
	Small Office	Stand-Alone Retail	Strip Mall
Add'l Insulation	R-19 batt	R-11 batt	R-11 batt
Ceiling			
Construction	Acoustic Tile	Acoustic Tile	Acoustic Tile
Insulation	varied	varied	varied
Windows			
Glass Category	Double Clr/Tint 1/4", 1/2" air	Double Clr/Tint 1/4", 1/2" air	Double Clr/Tint 1/4", 1/2" air
Window Area	70% of all walls	70% of North wall; all others 0%	70% of East wall; all others 0%
Lighting			
Lighting Density (W/Sq. Ft.)	1.330	2.030	2.030
HVAC			
Cooling Source	DX Coils	DX Coils	DX Coils
System Type	Packaged Single Zone	Packaged Single Zone	Packaged Single Zone
Typ. Unit Size	11.25 – 20 tons	5.4 – 7.5 tons	< 5.4 tons
EER (Base)	8.50 EER	8.90 EER	9.70 SEER
Heating Source	Furnace	Furnace	Furnace
Typ. Unit Size	> 225 kBTUh	< 225 kBTUh	< 225 kBTUh
Efficiency (AFUE)	0.806	0.780	0.780
Fans			
Min. Design Flow (cfm/ft^2)	0.50	0.50	0.50
Cycle Fans at Night?	Cycle Fans (no OA at night)	Cycle Fans (no OA at night)	Cycle Fans (no OA at night)
DHW			
Fuel	Natural Gas	Natural Gas	Natural Gas
Type	Storage	Storage	Storage
Tank Insulation R-Value	12.00	12.00	12.00
Tank Capacity (gal)	39	21	11

HVAC

The tables below provide the eQuest Equivalent Full Load Hours (EFLH) model results for various building types found in New Orleans. EFLH values developed in eQuest were then normalized with El Dorado, AR EFLH,.

eQuest Model EFLH Results

	El Dorado		New Orleans	
Building Type	**$EFLH_c$**	**$EFLH_h$**	**$EFLH_c$**	**$EFLH_h$**
Fast Food	2,111	411	3,013	178
Grocery	1,544	537	1,703	285
Health Clinic	1,317	510	1,451	325
Large Office	1,684	879	1,598	501
Lodging	5,833	588	7,647	372
Full Menu Restaurant	2,070	509	2,900	217
Retail	2,424	588	3,305	372
School	1,209	420	1,672	167
Small Office	1,564	115	2,098	37
University	1,755	771	1,799	602

EFHL Normalized Multipliers

	El Dorado		New Orleans	
Building Type	**$EFLH_c$**	**$EFLH_h$**	**$EFLH_c$**	**$EFLH_h$**
Fast Food	1.00	1.00	1.43	0.43
Grocery	1.00	1.00	1.10	0.53
Health Clinic	1.00	1.00	1.10	0.64
Large Office	1.00	1.00	0.95	0.57
Lodging	1.00	1.00	1.31	0.63
Full Menu Restaurant	1.00	1.00	1.40	0.43
Retail	1.00	1.00	1.36	0.63
School	1.00	1.00	1.38	0.40
Small Office	1.00	1.00	1.34	0.33
University	1.00	1.00	1.02	0.78

Lighting

The table below shows logger counts, standard deviations, and compare original AR TRM6 hours with figures derived from direct monitoring.

Commercial Lighting Updates

Facility or Space Type	***Count of Loggers***	***ARM TRM 6 hours***	***New Orleans Recommended Value***
Bar Area	12		2,676.0
Corridor/Hallway/Stairwell	39		5,537.3
Education: College/University		3,577.0	3,577.0

Education: K-12	9	2,777.0	2,333.5
Exterior		3,996.0	4,319.0
Food Prep (Generic)	9		5,543.2
Food Sales: 24-Hour Supermarket		6,900.0	6,900.0
Food Sales: Non 24-Hour Supermarket	5	4,706.0	2,058.2
Food Service: Fast Food	11	6,188.0	6,473.4
Food Service: Sit-Down Restaurant	13	4,368.0	4,730.6
Health Care: In-Patient	3	5,730.0	4,019.4
Health Care: Nursing Home		4,271.0	4,271.0
Health Care: Out-Patient		3,386.0	3,386.0
K-12 (specialized room)	9		3,248.1
Kwik-E-Mart	22		4,244.8
Lodging (Hotel/Motel/Dorm): Common Areas	22	6,630.0	4,126.9
Lodging (Hotel/Motel/Dorm): Room	13	3,055.0	3,369.9
Manufacturing		5,740.0	5,740.0
Multi-family Housing: Common Areas	24	4,772.0	5,703.4
Non-Warehouse Storage (Generic)	11		4,206.5
Office	27	3,737.0	5,158.5
Office (attached to other facility)	36		4,728.4
Parking Structure		7,884.0	7,884.0
Public Assembly		2,638.0	2,638.0
Public Order and Safety		3,472.0	3,472.0
Religious Gathering	8	1,824.0	3,174.3
Restroom (Generic)	11		3,515.6
Retail: Enclosed Mall		4,813.0	4,813.0
Retail: Freestanding	52	3,668.0	3,514.8
Retail: Other	4	4,527.0	4,311.8
Retail: Strip Mall		3,965.0	3,965.0
Security Booth	5		4,389.2
Service: Excluding Food		3,406.0	3,406.0
Showroom Floor	14		4,057.1
Walk-In Cooler (Generic)	6		792.3
Warehouse: Non-Refrigerated	9	3,501.0	2,416.7
Warehouse: Offices	4		2,791.8
Warehouse: Refrigerated		3,798.0	3,798.0

The table below presents standard wattages.

Standard Wattage Table

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED-SCRW		Integrated Ballast LEDs						
LED001-SCRW	LEDINT1W	Integrated Ballast LED, (1) 1W screw-in lamp/base, any bulb shape	1W LED - Int. Ballast	Electronic	N/A	N/A	1	9
LED002-SCRW	LEDINT2W	Integrated Ballast LED, (1) 2W screw-in lamp/base, any bulb shape	2W LED - Int. Ballast	Electronic	N/A	N/A	2	9
LED003-SCRW	LEDINT3W	Integrated Ballast LED, (1) 3W screw-in lamp/base, any bulb shape	3W LED - Int. Ballast	Electronic	N/A	N/A	3	9
LED004-SCRW	LEDINT4W	Integrated Ballast LED, (1) 4W screw-in lamp/base, any bulb shape	4W LED - Int. Ballast	Electronic	N/A	N/A	4	9
LED005-SCRW	LEDINT5W	Integrated Ballast LED, (1) 5W screw-in lamp/base, any bulb shape	5W LED - Int. Ballast	Electronic	N/A	N/A	5	9
LED006-SCRW	LEDINT6W	Integrated Ballast LED, (1) 6W screw-in lamp/base, any bulb shape	6W LED - Int. Ballast	Electronic	N/A	N/A	6	9
LED007-SCRW	LEDINT7W	Integrated Ballast LED, (1) 7W screw-in lamp/base, any bulb shape	7W LED - Int. Ballast	Electronic	N/A	N/A	7	9

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED008-SCRW	LEDINT8W	Integrated Ballast LED, (1) 8W screw-in lamp/base, any bulb shape	8W LED - Int. Ballast	Electronic	N/A	N/A	8	9
LED009-SCRW	LEDINT9W	Integrated Ballast LED, (1) 9W screw-in lamp/base, any bulb shape	9W LED - Int. Ballast	Electronic	N/A	N/A	9	9
LED010-SCRW	LEDINT10W	Integrated Ballast LED, (1) 10W screw-in lamp/base, any bulb shape	10W LED - Int. Ballast	Electronic	N/A	N/A	10	9
LED011-SCRW	LEDINT11W	Integrated Ballast LED, (1) 11W screw-in lamp/base, any bulb shape	11W LED - Int. Ballast	Electronic	N/A	N/A	11	9
LED012-SCRW	LEDINT12W	Integrated Ballast LED, (1) 12W screw-in lamp/base, any bulb shape	12W LED - Int. Ballast	Electronic	N/A	N/A	12	9
LED013-SCRW	LEDINT13W	Integrated Ballast LED, (1) 13W screw-in lamp/base, any bulb shape	13W LED - Int. Ballast	Electronic	N/A	N/A	13	9
LED014-SCRW	LEDINT14W	Integrated Ballast LED, (1) 14W screw-in lamp/base, any bulb shape	14W LED - Int. Ballast	Electronic	N/A	N/A	14	9
LED015-SCRW	LEDINT15W	Integrated Ballast LED, (1) 15W screw-in lamp/base, any bulb shape	15W LED - Int. Ballast	Electronic	N/A	N/A	15	9
LED016-SCRW	LEDINT16W	Integrated Ballast LED, (1) 16W screw-in lamp/base, any bulb shape	16W LED - Int. Ballast	Electronic	N/A	N/A	16	9
LED017-SCRW	LEDINT17W	Integrated Ballast LED, (1) 17W screw-in lamp/base, any bulb shape	17W LED - Int. Ballast	Electronic	N/A	N/A	17	9
LED018-SCRW	LEDINT18W	Integrated Ballast LED, (1) 18W screw-in lamp/base, any bulb shape	18W LED - Int. Ballast	Electronic	N/A	N/A	18	9

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED019-SCRW	LEDINT19W	Integrated Ballast LED, (1) 19W screw-in lamp/base, any bulb shape	19W LED - Int. Ballast	Electronic	N/A	N/A	19	9
LED020-SCRW	LEDINT20W	Integrated Ballast LED, (1) 20W screw-in lamp/base, any bulb shape	20W LED - Int. Ballast	Electronic	N/A	N/A	20	9
LED021-SCRW	LEDINT21W	Integrated Ballast LED, (1) 21W screw-in lamp/base, any bulb shape	21W LED - Int. Ballast	Electronic	N/A	N/A	21	9
LED022-SCRW	LEDINT22W	Integrated Ballast LED, (1) 22W screw-in lamp/base, any bulb shape	22W LED - Int. Ballast	Electronic	N/A	N/A	22	9
LED023-SCRW	LEDINT23W	Integrated Ballast LED, (1) 23W screw-in lamp/base, any bulb shape	23W LED - Int. Ballast	Electronic	N/A	N/A	23	9
LED024-SCRW	LEDINT24W	Integrated Ballast LED, (1) 24W screw-in lamp/base, any bulb shape	24W LED - Int. Ballast	Electronic	N/A	N/A	24	9
LED025-SCRW	LEDINT25W	Integrated Ballast LED, (1) 25W screw-in lamp/base, any bulb shape	25W LED - Int. Ballast	Electronic	N/A	N/A	25	9
LED026-SCRW	LEDINT26W	Integrated Ballast LED, (1) 26W screw-in lamp/base, any bulb shape	26W LED - Int. Ballast	Electronic	N/A	N/A	26	9
LED027-SCRW	LEDINT27W	Integrated Ballast LED, (1) 27W screw-in lamp/base, any bulb shape	27W LED - Int. Ballast	Electronic	N/A	N/A	27	9
LED028-SCRW	LEDINT28W	Integrated Ballast LED, (1) 28W screw-in lamp/base, any bulb shape	28W LED - Int. Ballast	Electronic	N/A	N/A	28	9
LED029-SCRW	LEDINT29W	Integrated Ballast LED, (1) 29W screw-in lamp/base, any bulb shape	29W LED - Int. Ballast	Electronic	N/A	N/A	29	9

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED030-SCRW	LEDINT30W	Integrated Ballast LED, (1) 30W screw-in lamp/base, any bulb shape	30W LED - Int. Ballast	Electronic	N/A	N/A	30	9
LED031-SCRW	LEDINT31W	Integrated Ballast LED, (1) 31W screw-in lamp/base, any bulb shape	31W LED - Int. Ballast	Electronic	N/A	N/A	31	9
LED032-SCRW	LEDINT32W	Integrated Ballast LED, (1) 32W screw-in lamp/base, any bulb shape	32W LED - Int. Ballast	Electronic	N/A	N/A	32	9
LED033-SCRW	LEDINT33W	Integrated Ballast LED, (1) 33W screw-in lamp/base, any bulb shape	33W LED - Int. Ballast	Electronic	N/A	N/A	33	9
LED034-SCRW	LEDINT34W	Integrated Ballast LED, (1) 34W screw-in lamp/base, any bulb shape	34W LED - Int. Ballast	Electronic	N/A	N/A	34	9
LED035-SCRW	LEDINT35W	Integrated Ballast LED, (1) 35W screw-in lamp/base, any bulb shape	35W LED - Int. Ballast	Electronic	N/A	N/A	35	9
LED036-SCRW	LEDINT36W	Integrated Ballast LED, (1) 36W screw-in lamp/base, any bulb shape	36W LED - Int. Ballast	Electronic	N/A	N/A	36	9
LED037-SCRW	LEDINT37W	Integrated Ballast LED, (1) 37W screw-in lamp/base, any bulb shape	37W LED - Int. Ballast	Electronic	N/A	N/A	37	9
LED038-SCRW	LEDINT38W	Integrated Ballast LED, (1) 38W screw-in lamp/base, any bulb shape	38W LED - Int. Ballast	Electronic	N/A	N/A	38	9
LED039-SCRW	LEDINT39W	Integrated Ballast LED, (1) 39W screw-in lamp/base, any bulb shape	39W LED - Int. Ballast	Electronic	N/A	N/A	39	9
LED040-SCRW	LEDINT40W	Integrated Ballast LED, (1) 40W screw-in lamp/base, any bulb shape	40W LED - Int. Ballast	Electronic	N/A	N/A	40	9

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED041-SCRW	LEDINT41W	Integrated Ballast LED, (1) 41W screw-in lamp/base, any bulb shape	41W LED - Int. Ballast	Electronic	N/A	N/A	41	9
LED042-SCRW	LEDINT42W	Integrated Ballast LED, (1) 42W screw-in lamp/base, any bulb shape	42W LED - Int. Ballast	Electronic	N/A	N/A	42	9
LED043-SCRW	LEDINT43W	Integrated Ballast LED, (1) 43W screw-in lamp/base, any bulb shape	43W LED - Int. Ballast	Electronic	N/A	N/A	43	9
LED044-SCRW	LEDINT44W	Integrated Ballast LED, (1) 44W screw-in lamp/base, any bulb shape	44W LED - Int. Ballast	Electronic	N/A	N/A	44	9
LED045-SCRW	LEDINT45W	Integrated Ballast LED, (1) 45W screw-in lamp/base, any bulb shape	45W LED - Int. Ballast	Electronic	N/A	N/A	45	9
LED046-SCRW	LEDINT46W	Integrated Ballast LED, (1) 46W screw-in lamp/base, any bulb shape	46W LED - Int. Ballast	Electronic	N/A	N/A	46	9
LED047-SCRW	LEDINT47W	Integrated Ballast LED, (1) 47W screw-in lamp/base, any bulb shape	47W LED - Int. Ballast	Electronic	N/A	N/A	47	9
LED048-SCRW	LEDINT48W	Integrated Ballast LED, (1) 48W screw-in lamp/base, any bulb shape	48W LED - Int. Ballast	Electronic	N/A	N/A	48	9
LED049-SCRW	LEDINT49W	Integrated Ballast LED, (1) 49W screw-in lamp/base, any bulb shape	49W LED - Int. Ballast	Electronic	N/A	N/A	49	9
LED050-SCRW	LEDINT50W	Integrated Ballast LED, (1) 50W screw-in lamp/base, any bulb shape	50W LED - Int. Ballast	Electronic	N/A	N/A	50	9
LED-FIXT		Non-Integrated Ballast LEDs						
LED001-	LED1W	Non-Integrated Ballast LED, 1W, any bulb shape, any application	1W LED - Non-Int.	Electronic	N/A	N/A	1	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
FIXT			Ballast					
LED002-FIXT	LED2W	Non-Integrated Ballast LED, 2W, any bulb shape, any application	2W LED - Non-Int. Ballast	Electronic	N/A	N/A	2	15
LED003-FIXT	LED3W	Non-Integrated Ballast LED, 3W, any bulb shape, any application	3W LED - Non-Int. Ballast	Electronic	N/A	N/A	3	15
LED004-FIXT	LED4W	Non-Integrated Ballast LED, 4W, any bulb shape, any application	4W LED - Non-Int. Ballast	Electronic	N/A	N/A	4	15
LED005-FIXT	LED5W	Non-Integrated Ballast LED, 5W, any bulb shape, any application	5W LED - Non-Int. Ballast	Electronic	N/A	N/A	5	15
LED006-FIXT	LED6W	Non-Integrated Ballast LED, 6W, any bulb shape, any application	6W LED - Non-Int. Ballast	Electronic	N/A	N/A	6	15
LED007-FIXT	LED7W	Non-Integrated Ballast LED, 7W, any bulb shape, any application	7W LED - Non-Int. Ballast	Electronic	N/A	N/A	7	15
LED008-FIXT	LED8W	Non-Integrated Ballast LED, 8W, any bulb shape, any application	8W LED - Non-Int. Ballast	Electronic	N/A	N/A	8	15
LED009-FIXT	LED9W	Non-Integrated Ballast LED, 9W, any bulb shape, any application	9W LED - Non-Int. Ballast	Electronic	N/A	N/A	9	15
LED010-FIXT	LED10W	Non-Integrated Ballast LED, 10W, any bulb shape, any application	10W LED - Non-Int. Ballast	Electronic	N/A	N/A	10	15
LED011-FIXT	LED11W	Non-Integrated Ballast LED, 11W, any bulb shape, any application	11W LED - Non-Int. Ballast	Electronic	N/A	N/A	11	15
LED012-FIXT	LED12W	Non-Integrated Ballast LED, 12W, any bulb shape, any application	12W LED - Non-Int. Ballast	Electronic	N/A	N/A	12	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED013-FIXT	LED13W	Non-Integrated Ballast LED, 13W, any bulb shape, any application	13W LED - Non-Int. Ballast	Electronic	N/A	N/A	13	15
LED014-FIXT	LED14W	Non-Integrated Ballast LED, 14W, any bulb shape, any application	14W LED - Non-Int. Ballast	Electronic	N/A	N/A	14	15
LED015-FIXT	LED15W	Non-Integrated Ballast LED, 15W, any bulb shape, any application	15W LED - Non-Int. Ballast	Electronic	N/A	N/A	15	15
LED016-FIXT	LED16W	Non-Integrated Ballast LED, 16W, any bulb shape, any application	16W LED - Non-Int. Ballast	Electronic	N/A	N/A	16	15
LED017-FIXT	LED17W	Non-Integrated Ballast LED, 17W, any bulb shape, any application	17W LED - Non-Int. Ballast	Electronic	N/A	N/A	17	15
LED018-FIXT	LED18W	Non-Integrated Ballast LED, 18W, any bulb shape, any application	18W LED - Non-Int. Ballast	Electronic	N/A	N/A	18	15
LED019-FIXT	LED19W	Non-Integrated Ballast LED, 19W, any bulb shape, any application	19W LED - Non-Int. Ballast	Electronic	N/A	N/A	19	15
LED020-FIXT	LED20W	Non-Integrated Ballast LED, 20W, any bulb shape, any application	20W LED - Non-Int. Ballast	Electronic	N/A	N/A	20	15
LED021-FIXT	LED21W	Non-Integrated Ballast LED, 21W, any bulb shape, any application	21W LED - Non-Int. Ballast	Electronic	N/A	N/A	21	15
LED022-FIXT	LED22W	Non-Integrated Ballast LED, 22W, any bulb shape, any application	22W LED - Non-Int. Ballast	Electronic	N/A	N/A	22	15
LED023-FIXT	LED23W	Non-Integrated Ballast LED, 23W, any bulb shape, any application	23W LED - Non-Int. Ballast	Electronic	N/A	N/A	23	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED024-FIXT	LED24W	Non-Integrated Ballast LED, 24W, any bulb shape, any application	24W LED - Non-Int. Ballast	Electronic	N/A	N/A	24	15
LED025-FIXT	LED25W	Non-Integrated Ballast LED, 25W, any bulb shape, any application	25W LED - Non-Int. Ballast	Electronic	N/A	N/A	25	15
LED026-FIXT	LED26W	Non-Integrated Ballast LED, 26W, any bulb shape, any application	26W LED - Non-Int. Ballast	Electronic	N/A	N/A	26	15
LED027-FIXT	LED27W	Non-Integrated Ballast LED, 27W, any bulb shape, any application	27W LED - Non-Int. Ballast	Electronic	N/A	N/A	27	15
LED028-FIXT	LED28W	Non-Integrated Ballast LED, 28W, any bulb shape, any application	28W LED - Non-Int. Ballast	Electronic	N/A	N/A	28	15
LED029-FIXT	LED29W	Non-Integrated Ballast LED, 29W, any bulb shape, any application	29W LED - Non-Int. Ballast	Electronic	N/A	N/A	29	15
LED030-FIXT	LED30W	Non-Integrated Ballast LED, 30W, any bulb shape, any application	30W LED - Non-Int. Ballast	Electronic	N/A	N/A	30	15
LED031-FIXT	LED31W	Non-Integrated Ballast LED, 31W, any bulb shape, any application	31W LED - Non-Int. Ballast	Electronic	N/A	N/A	31	15
LED032-FIXT	LED32W	Non-Integrated Ballast LED, 32W, any bulb shape, any application	32W LED - Non-Int. Ballast	Electronic	N/A	N/A	32	15
LED033-FIXT	LED33W	Non-Integrated Ballast LED, 33W, any bulb shape, any application	33W LED - Non-Int. Ballast	Electronic	N/A	N/A	33	15
LED034-FIXT	LED34W	Non-Integrated Ballast LED, 34W, any bulb shape, any application	34W LED - Non-Int. Ballast	Electronic	N/A	N/A	34	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED035-FIXT	LED35W	Non-Integrated Ballast LED, 35W, any bulb shape, any application	35W LED - Non-Int. Ballast	Electronic	N/A	N/A	35	15
LED036-FIXT	LED36W	Non-Integrated Ballast LED, 36W, any bulb shape, any application	36W LED - Non-Int. Ballast	Electronic	N/A	N/A	36	15
LED037-FIXT	LED37W	Non-Integrated Ballast LED, 37W, any bulb shape, any application	37W LED - Non-Int. Ballast	Electronic	N/A	N/A	37	15
LED038-FIXT	LED38W	Non-Integrated Ballast LED, 38W, any bulb shape, any application	38W LED - Non-Int. Ballast	Electronic	N/A	N/A	38	15
LED039-FIXT	LED39W	Non-Integrated Ballast LED, 39W, any bulb shape, any application	39W LED - Non-Int. Ballast	Electronic	N/A	N/A	39	15
LED040-FIXT	LED40W	Non-Integrated Ballast LED, 40W, any bulb shape, any application	40W LED - Non-Int. Ballast	Electronic	N/A	N/A	40	15
LED041-FIXT	LED41W	Non-Integrated Ballast LED, 41W, any bulb shape, any application	41W LED - Non-Int. Ballast	Electronic	N/A	N/A	41	15
LED042-FIXT	LED42W	Non-Integrated Ballast LED, 42W, any bulb shape, any application	42W LED - Non-Int. Ballast	Electronic	N/A	N/A	42	15
LED043-FIXT	LED43W	Non-Integrated Ballast LED, 43W, any bulb shape, any application	43W LED - Non-Int. Ballast	Electronic	N/A	N/A	43	15
LED044-FIXT	LED44W	Non-Integrated Ballast LED, 44W, any bulb shape, any application	44W LED - Non-Int. Ballast	Electronic	N/A	N/A	44	15
LED045-FIXT	LED45W	Non-Integrated Ballast LED, 45W, any bulb shape, any application	45W LED - Non-Int. Ballast	Electronic	N/A	N/A	45	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED046-FIXT	LED46W	Non-Integrated Ballast LED, 46W, any bulb shape, any application	46W LED - Non-Int. Ballast	Electronic	N/A	N/A	46	15
LED047-FIXT	LED47W	Non-Integrated Ballast LED, 47W, any bulb shape, any application	47W LED - Non-Int. Ballast	Electronic	N/A	N/A	47	15
LED048-FIXT	LED48W	Non-Integrated Ballast LED, 48W, any bulb shape, any application	48W LED - Non-Int. Ballast	Electronic	N/A	N/A	48	15
LED049-FIXT	LED49W	Non-Integrated Ballast LED, 49W, any bulb shape, any application	49W LED - Non-Int. Ballast	Electronic	N/A	N/A	49	15
LED050-FIXT	LED50W	Non-Integrated Ballast LED, 50W, any bulb shape, any application	50W LED - Non-Int. Ballast	Electronic	N/A	N/A	50	15
LED051-FIXT	LED51W	Non-Integrated Ballast LED, 51W, any bulb shape, any application	51W LED - Non-Int. Ballast	Electronic	N/A	N/A	51	15
LED052-FIXT	LED52W	Non-Integrated Ballast LED, 52W, any bulb shape, any application	52W LED - Non-Int. Ballast	Electronic	N/A	N/A	52	15
LED053-FIXT	LED53W	Non-Integrated Ballast LED, 53W, any bulb shape, any application	53W LED - Non-Int. Ballast	Electronic	N/A	N/A	53	15
LED054-FIXT	LED54W	Non-Integrated Ballast LED, 54W, any bulb shape, any application	54W LED - Non-Int. Ballast	Electronic	N/A	N/A	54	15
LED055-FIXT	LED55W	Non-Integrated Ballast LED, 55W, any bulb shape, any application	55W LED - Non-Int. Ballast	Electronic	N/A	N/A	55	15
LED056-FIXT	LED56W	Non-Integrated Ballast LED, 56W, any bulb shape, any application	56W LED - Non-Int. Ballast	Electronic	N/A	N/A	56	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED057-FIXT	LED57W	Non-Integrated Ballast LED, 57W, any bulb shape, any application	57W LED - Non-Int. Ballast	Electronic	N/A	N/A	57	15
LED058-FIXT	LED58W	Non-Integrated Ballast LED, 58W, any bulb shape, any application	58W LED - Non-Int. Ballast	Electronic	N/A	N/A	58	15
LED059-FIXT	LED59W	Non-Integrated Ballast LED, 59W, any bulb shape, any application	59W LED - Non-Int. Ballast	Electronic	N/A	N/A	59	15
LED060-FIXT	LED60W	Non-Integrated Ballast LED, 60W, any bulb shape, any application	60W LED - Non-Int. Ballast	Electronic	N/A	N/A	60	15
LED061-FIXT	LED61W	Non-Integrated Ballast LED, 61W, any bulb shape, any application	61W LED - Non-Int. Ballast	Electronic	N/A	N/A	61	15
LED062-FIXT	LED62W	Non-Integrated Ballast LED, 62W, any bulb shape, any application	62W LED - Non-Int. Ballast	Electronic	N/A	N/A	62	15
LED063-FIXT	LED63W	Non-Integrated Ballast LED, 63W, any bulb shape, any application	63W LED - Non-Int. Ballast	Electronic	N/A	N/A	63	15
LED064-FIXT	LED64W	Non-Integrated Ballast LED, 64W, any bulb shape, any application	64W LED - Non-Int. Ballast	Electronic	N/A	N/A	64	15
LED065-FIXT	LED65W	Non-Integrated Ballast LED, 65W, any bulb shape, any application	65W LED - Non-Int. Ballast	Electronic	N/A	N/A	65	15
LED066-FIXT	LED66W	Non-Integrated Ballast LED, 66W, any bulb shape, any application	66W LED - Non-Int. Ballast	Electronic	N/A	N/A	66	15
LED067-FIXT	LED67W	Non-Integrated Ballast LED, 67W, any bulb shape, any application	67W LED - Non-Int. Ballast	Electronic	N/A	N/A	67	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED068-FIXT	LED68W	Non-Integrated Ballast LED, 68W, any bulb shape, any application	68W LED - Non-Int. Ballast	Electronic	N/A	N/A	68	15
LED069-FIXT	LED69W	Non-Integrated Ballast LED, 69W, any bulb shape, any application	69W LED - Non-Int. Ballast	Electronic	N/A	N/A	69	15
LED070-FIXT	LED70W	Non-Integrated Ballast LED, 70W, any bulb shape, any application	70W LED - Non-Int. Ballast	Electronic	N/A	N/A	70	15
LED071-FIXT	LED71W	Non-Integrated Ballast LED, 71W, any bulb shape, any application	71W LED - Non-Int. Ballast	Electronic	N/A	N/A	71	15
LED072-FIXT	LED72W	Non-Integrated Ballast LED, 72W, any bulb shape, any application	72W LED - Non-Int. Ballast	Electronic	N/A	N/A	72	15
LED073-FIXT	LED73W	Non-Integrated Ballast LED, 73W, any bulb shape, any application	73W LED - Non-Int. Ballast	Electronic	N/A	N/A	73	15
LED074-FIXT	LED74W	Non-Integrated Ballast LED, 74W, any bulb shape, any application	74W LED - Non-Int. Ballast	Electronic	N/A	N/A	74	15
LED075-FIXT	LED75W	Non-Integrated Ballast LED, 75W, any bulb shape, any application	75W LED - Non-Int. Ballast	Electronic	N/A	N/A	75	15
LED076-FIXT	LED76W	Non-Integrated Ballast LED, 76W, any bulb shape, any application	76W LED - Non-Int. Ballast	Electronic	N/A	N/A	76	15
LED077-FIXT	LED77W	Non-Integrated Ballast LED, 77W, any bulb shape, any application	77W LED - Non-Int. Ballast	Electronic	N/A	N/A	77	15
LED078-FIXT	LED78W	Non-Integrated Ballast LED, 78W, any bulb shape, any application	78W LED - Non-Int. Ballast	Electronic	N/A	N/A	78	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED079-FIXT	LED79W	Non-Integrated Ballast LED, 79W, any bulb shape, any application	79W LED - Non-Int. Ballast	Electronic	N/A	N/A	79	15
LED080-FIXT	LED80W	Non-Integrated Ballast LED, 80W, any bulb shape, any application	80W LED - Non-Int. Ballast	Electronic	N/A	N/A	80	15
LED081-FIXT	LED81W	Non-Integrated Ballast LED, 81W, any bulb shape, any application	81W LED - Non-Int. Ballast	Electronic	N/A	N/A	81	15
LED082-FIXT	LED82W	Non-Integrated Ballast LED, 82W, any bulb shape, any application	82W LED - Non-Int. Ballast	Electronic	N/A	N/A	82	15
LED083-FIXT	LED83W	Non-Integrated Ballast LED, 83W, any bulb shape, any application	83W LED - Non-Int. Ballast	Electronic	N/A	N/A	83	15
LED084-FIXT	LED84W	Non-Integrated Ballast LED, 84W, any bulb shape, any application	84W LED - Non-Int. Ballast	Electronic	N/A	N/A	84	15
LED085-FIXT	LED85W	Non-Integrated Ballast LED, 85W, any bulb shape, any application	85W LED - Non-Int. Ballast	Electronic	N/A	N/A	85	15
LED086-FIXT	LED86W	Non-Integrated Ballast LED, 86W, any bulb shape, any application	86W LED - Non-Int. Ballast	Electronic	N/A	N/A	86	15
LED087-FIXT	LED87W	Non-Integrated Ballast LED, 87W, any bulb shape, any application	87W LED - Non-Int. Ballast	Electronic	N/A	N/A	87	15
LED088-FIXT	LED88W	Non-Integrated Ballast LED, 88W, any bulb shape, any application	88W LED - Non-Int. Ballast	Electronic	N/A	N/A	88	15
LED089-FIXT	LED89W	Non-Integrated Ballast LED, 89W, any bulb shape, any application	89W LED - Non-Int. Ballast	Electronic	N/A	N/A	89	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED090-FIXT	LED90W	Non-Integrated Ballast LED, 90W, any bulb shape, any application	90W LED - Non-Int. Ballast	Electronic	N/A	N/A	90	15
LED091-FIXT	LED91W	Non-Integrated Ballast LED, 91W, any bulb shape, any application	91W LED - Non-Int. Ballast	Electronic	N/A	N/A	91	15
LED092-FIXT	LED92W	Non-Integrated Ballast LED, 92W, any bulb shape, any application	92W LED - Non-Int. Ballast	Electronic	N/A	N/A	92	15
LED093-FIXT	LED93W	Non-Integrated Ballast LED, 93W, any bulb shape, any application	93W LED - Non-Int. Ballast	Electronic	N/A	N/A	93	15
LED094-FIXT	LED94W	Non-Integrated Ballast LED, 94W, any bulb shape, any application	94W LED - Non-Int. Ballast	Electronic	N/A	N/A	94	15
LED095-FIXT	LED95W	Non-Integrated Ballast LED, 95W, any bulb shape, any application	95W LED - Non-Int. Ballast	Electronic	N/A	N/A	95	15
LED096-FIXT	LED96W	Non-Integrated Ballast LED, 96W, any bulb shape, any application	96W LED - Non-Int. Ballast	Electronic	N/A	N/A	96	15
LED097-FIXT	LED97W	Non-Integrated Ballast LED, 97W, any bulb shape, any application	97W LED - Non-Int. Ballast	Electronic	N/A	N/A	97	15
LED098-FIXT	LED98W	Non-Integrated Ballast LED, 98W, any bulb shape, any application	98W LED - Non-Int. Ballast	Electronic	N/A	N/A	98	15
LED099-FIXT	LED99W	Non-Integrated Ballast LED, 99W, any bulb shape, any application	99W LED - Non-Int. Ballast	Electronic	N/A	N/A	99	15
LED100-FIXT	LED100W	Non-Integrated Ballast LED, 100W, any bulb shape, any application	100W LED - Non-Int. Ballast	Electronic	N/A	N/A	100	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED101-FIXT	LED101W	Non-Integrated Ballast LED, 101W, any bulb shape, any application	101W LED - Non-Int. Ballast	Electronic	N/A	N/A	101	15
LED102-FIXT	LED102W	Non-Integrated Ballast LED, 102W, any bulb shape, any application	102W LED - Non-Int. Ballast	Electronic	N/A	N/A	102	15
LED103-FIXT	LED103W	Non-Integrated Ballast LED, 103W, any bulb shape, any application	103W LED - Non-Int. Ballast	Electronic	N/A	N/A	103	15
LED104-FIXT	LED104W	Non-Integrated Ballast LED, 104W, any bulb shape, any application	104W LED - Non-Int. Ballast	Electronic	N/A	N/A	104	15
LED105-FIXT	LED105W	Non-Integrated Ballast LED, 105W, any bulb shape, any application	105W LED - Non-Int. Ballast	Electronic	N/A	N/A	105	15
LED106-FIXT	LED106W	Non-Integrated Ballast LED, 106W, any bulb shape, any application	106W LED - Non-Int. Ballast	Electronic	N/A	N/A	106	15
LED107-FIXT	LED107W	Non-Integrated Ballast LED, 107W, any bulb shape, any application	107W LED - Non-Int. Ballast	Electronic	N/A	N/A	107	15
LED108-FIXT	LED108W	Non-Integrated Ballast LED, 108W, any bulb shape, any application	108W LED - Non-Int. Ballast	Electronic	N/A	N/A	108	15
LED109-FIXT	LED109W	Non-Integrated Ballast LED, 109W, any bulb shape, any application	109W LED - Non-Int. Ballast	Electronic	N/A	N/A	109	15
LED110-FIXT	LED110W	Non-Integrated Ballast LED, 110W, any bulb shape, any application	110W LED - Non-Int. Ballast	Electronic	N/A	N/A	110	15
LED111-FIXT	LED111W	Non-Integrated Ballast LED, 111W, any bulb shape, any application	111W LED - Non-Int. Ballast	Electronic	N/A	N/A	111	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED112-FIXT	LED112W	Non-Integrated Ballast LED, 112W, any bulb shape, any application	112W LED - Non-Int. Ballast	Electronic	N/A	N/A	112	15
LED113-FIXT	LED113W	Non-Integrated Ballast LED, 113W, any bulb shape, any application	113W LED - Non-Int. Ballast	Electronic	N/A	N/A	113	15
LED114-FIXT	LED114W	Non-Integrated Ballast LED, 114W, any bulb shape, any application	114W LED - Non-Int. Ballast	Electronic	N/A	N/A	114	15
LED115-FIXT	LED115W	Non-Integrated Ballast LED, 115W, any bulb shape, any application	115W LED - Non-Int. Ballast	Electronic	N/A	N/A	115	15
LED116-FIXT	LED116W	Non-Integrated Ballast LED, 116W, any bulb shape, any application	116W LED - Non-Int. Ballast	Electronic	N/A	N/A	116	15
LED117-FIXT	LED117W	Non-Integrated Ballast LED, 117W, any bulb shape, any application	117W LED - Non-Int. Ballast	Electronic	N/A	N/A	117	15
LED118-FIXT	LED118W	Non-Integrated Ballast LED, 118W, any bulb shape, any application	118W LED - Non-Int. Ballast	Electronic	N/A	N/A	118	15
LED119-FIXT	LED119W	Non-Integrated Ballast LED, 119W, any bulb shape, any application	119W LED - Non-Int. Ballast	Electronic	N/A	N/A	119	15
LED120-FIXT	LED120W	Non-Integrated Ballast LED, 120W, any bulb shape, any application	120W LED - Non-Int. Ballast	Electronic	N/A	N/A	120	15
LED121-FIXT	LED121W	Non-Integrated Ballast LED, 121W, any bulb shape, any application	121W LED - Non-Int. Ballast	Electronic	N/A	N/A	121	15
LED122-FIXT	LED122W	Non-Integrated Ballast LED, 122W, any bulb shape, any application	122W LED - Non-Int. Ballast	Electronic	N/A	N/A	122	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED123-FIXT	LED123W	Non-Integrated Ballast LED, 123W, any bulb shape, any application	123W LED - Non-Int. Ballast	Electronic	N/A	N/A	123	15
LED124-FIXT	LED124W	Non-Integrated Ballast LED, 124W, any bulb shape, any application	124W LED - Non-Int. Ballast	Electronic	N/A	N/A	124	15
LED125-FIXT	LED125W	Non-Integrated Ballast LED, 125W, any bulb shape, any application	125W LED - Non-Int. Ballast	Electronic	N/A	N/A	125	15
LED126-FIXT	LED126W	Non-Integrated Ballast LED, 126W, any bulb shape, any application	126W LED - Non-Int. Ballast	Electronic	N/A	N/A	126	15
LED127-FIXT	LED127W	Non-Integrated Ballast LED, 127W, any bulb shape, any application	127W LED - Non-Int. Ballast	Electronic	N/A	N/A	127	15
LED128-FIXT	LED128W	Non-Integrated Ballast LED, 128W, any bulb shape, any application	128W LED - Non-Int. Ballast	Electronic	N/A	N/A	128	15
LED129-FIXT	LED129W	Non-Integrated Ballast LED, 129W, any bulb shape, any application	129W LED - Non-Int. Ballast	Electronic	N/A	N/A	129	15
LED130-FIXT	LED130W	Non-Integrated Ballast LED, 130W, any bulb shape, any application	130W LED - Non-Int. Ballast	Electronic	N/A	N/A	130	15
LED131-FIXT	LED131W	Non-Integrated Ballast LED, 131W, any bulb shape, any application	131W LED - Non-Int. Ballast	Electronic	N/A	N/A	131	15
LED132-FIXT	LED132W	Non-Integrated Ballast LED, 132W, any bulb shape, any application	132W LED - Non-Int. Ballast	Electronic	N/A	N/A	132	15
LED133-FIXT	LED133W	Non-Integrated Ballast LED, 133W, any bulb shape, any application	133W LED - Non-Int. Ballast	Electronic	N/A	N/A	133	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED134-FIXT	LED134W	Non-Integrated Ballast LED, 134W, any bulb shape, any application	134W LED - Non-Int. Ballast	Electronic	N/A	N/A	134	15
LED135-FIXT	LED135W	Non-Integrated Ballast LED, 135W, any bulb shape, any application	135W LED - Non-Int. Ballast	Electronic	N/A	N/A	135	15
LED136-FIXT	LED136W	Non-Integrated Ballast LED, 136W, any bulb shape, any application	136W LED - Non-Int. Ballast	Electronic	N/A	N/A	136	15
LED137-FIXT	LED137W	Non-Integrated Ballast LED, 137W, any bulb shape, any application	137W LED - Non-Int. Ballast	Electronic	N/A	N/A	137	15
LED138-FIXT	LED138W	Non-Integrated Ballast LED, 138W, any bulb shape, any application	138W LED - Non-Int. Ballast	Electronic	N/A	N/A	138	15
LED139-FIXT	LED139W	Non-Integrated Ballast LED, 139W, any bulb shape, any application	139W LED - Non-Int. Ballast	Electronic	N/A	N/A	139	15
LED140-FIXT	LED140W	Non-Integrated Ballast LED, 140W, any bulb shape, any application	140W LED - Non-Int. Ballast	Electronic	N/A	N/A	140	15
LED141-FIXT	LED141W	Non-Integrated Ballast LED, 141W, any bulb shape, any application	141W LED - Non-Int. Ballast	Electronic	N/A	N/A	141	15
LED142-FIXT	LED142W	Non-Integrated Ballast LED, 142W, any bulb shape, any application	142W LED - Non-Int. Ballast	Electronic	N/A	N/A	142	15
LED143-FIXT	LED143W	Non-Integrated Ballast LED, 143W, any bulb shape, any application	143W LED - Non-Int. Ballast	Electronic	N/A	N/A	143	15
LED144-FIXT	LED144W	Non-Integrated Ballast LED, 144W, any bulb shape, any application	144W LED - Non-Int. Ballast	Electronic	N/A	N/A	144	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED145-FIXT	LED145W	Non-Integrated Ballast LED, 145W, any bulb shape, any application	145W LED - Non-Int. Ballast	Electronic	N/A	N/A	145	15
LED146-FIXT	LED146W	Non-Integrated Ballast LED, 146W, any bulb shape, any application	146W LED - Non-Int. Ballast	Electronic	N/A	N/A	146	15
LED147-FIXT	LED147W	Non-Integrated Ballast LED, 147W, any bulb shape, any application	147W LED - Non-Int. Ballast	Electronic	N/A	N/A	147	15
LED148-FIXT	LED148W	Non-Integrated Ballast LED, 148W, any bulb shape, any application	148W LED - Non-Int. Ballast	Electronic	N/A	N/A	148	15
LED149-FIXT	LED149W	Non-Integrated Ballast LED, 149W, any bulb shape, any application	149W LED - Non-Int. Ballast	Electronic	N/A	N/A	149	15
LED150-FIXT	LED150W	Non-Integrated Ballast LED, 150W, any bulb shape, any application	150W LED - Non-Int. Ballast	Electronic	N/A	N/A	150	15
LED151-FIXT	LED151W	Non-Integrated Ballast LED, 151W, any bulb shape, any application	151W LED - Non-Int. Ballast	Electronic	N/A	N/A	151	15
LED152-FIXT	LED152W	Non-Integrated Ballast LED, 152W, any bulb shape, any application	152W LED - Non-Int. Ballast	Electronic	N/A	N/A	152	15
LED153-FIXT	LED153W	Non-Integrated Ballast LED, 153W, any bulb shape, any application	153W LED - Non-Int. Ballast	Electronic	N/A	N/A	153	15
LED154-FIXT	LED154W	Non-Integrated Ballast LED, 154W, any bulb shape, any application	154W LED - Non-Int. Ballast	Electronic	N/A	N/A	154	15
LED155-FIXT	LED155W	Non-Integrated Ballast LED, 155W, any bulb shape, any application	155W LED - Non-Int. Ballast	Electronic	N/A	N/A	155	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED156-FIXT	LED156W	Non-Integrated Ballast LED, 156W, any bulb shape, any application	156W LED - Non-Int. Ballast	Electronic	N/A	N/A	156	15
LED157-FIXT	LED157W	Non-Integrated Ballast LED, 157W, any bulb shape, any application	157W LED - Non-Int. Ballast	Electronic	N/A	N/A	157	15
LED158-FIXT	LED158W	Non-Integrated Ballast LED, 158W, any bulb shape, any application	158W LED - Non-Int. Ballast	Electronic	N/A	N/A	158	15
LED159-FIXT	LED159W	Non-Integrated Ballast LED, 159W, any bulb shape, any application	159W LED - Non-Int. Ballast	Electronic	N/A	N/A	159	15
LED160-FIXT	LED160W	Non-Integrated Ballast LED, 160W, any bulb shape, any application	160W LED - Non-Int. Ballast	Electronic	N/A	N/A	160	15
LED161-FIXT	LED161W	Non-Integrated Ballast LED, 161W, any bulb shape, any application	161W LED - Non-Int. Ballast	Electronic	N/A	N/A	161	15
LED162-FIXT	LED162W	Non-Integrated Ballast LED, 162W, any bulb shape, any application	162W LED - Non-Int. Ballast	Electronic	N/A	N/A	162	15
LED163-FIXT	LED163W	Non-Integrated Ballast LED, 163W, any bulb shape, any application	163W LED - Non-Int. Ballast	Electronic	N/A	N/A	163	15
LED164-FIXT	LED164W	Non-Integrated Ballast LED, 164W, any bulb shape, any application	164W LED - Non-Int. Ballast	Electronic	N/A	N/A	164	15
LED165-FIXT	LED165W	Non-Integrated Ballast LED, 165W, any bulb shape, any application	165W LED - Non-Int. Ballast	Electronic	N/A	N/A	165	15
LED166-FIXT	LED166W	Non-Integrated Ballast LED, 166W, any bulb shape, any application	166W LED - Non-Int. Ballast	Electronic	N/A	N/A	166	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED167-FIXT	LED167W	Non-Integrated Ballast LED, 167W, any bulb shape, any application	167W LED - Non-Int. Ballast	Electronic	N/A	N/A	167	15
LED168-FIXT	LED168W	Non-Integrated Ballast LED, 168W, any bulb shape, any application	168W LED - Non-Int. Ballast	Electronic	N/A	N/A	168	15
LED169-FIXT	LED169W	Non-Integrated Ballast LED, 169W, any bulb shape, any application	169W LED - Non-Int. Ballast	Electronic	N/A	N/A	169	15
LED170-FIXT	LED170W	Non-Integrated Ballast LED, 170W, any bulb shape, any application	170W LED - Non-Int. Ballast	Electronic	N/A	N/A	170	15
LED171-FIXT	LED171W	Non-Integrated Ballast LED, 171W, any bulb shape, any application	171W LED - Non-Int. Ballast	Electronic	N/A	N/A	171	15
LED172-FIXT	LED172W	Non-Integrated Ballast LED, 172W, any bulb shape, any application	172W LED - Non-Int. Ballast	Electronic	N/A	N/A	172	15
LED173-FIXT	LED173W	Non-Integrated Ballast LED, 173W, any bulb shape, any application	173W LED - Non-Int. Ballast	Electronic	N/A	N/A	173	15
LED174-FIXT	LED174W	Non-Integrated Ballast LED, 174W, any bulb shape, any application	174W LED - Non-Int. Ballast	Electronic	N/A	N/A	174	15
LED175-FIXT	LED175W	Non-Integrated Ballast LED, 175W, any bulb shape, any application	175W LED - Non-Int. Ballast	Electronic	N/A	N/A	175	15
LED176-FIXT	LED176W	Non-Integrated Ballast LED, 176W, any bulb shape, any application	176W LED - Non-Int. Ballast	Electronic	N/A	N/A	176	15
LED177-FIXT	LED177W	Non-Integrated Ballast LED, 177W, any bulb shape, any application	177W LED - Non-Int. Ballast	Electronic	N/A	N/A	177	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED178-FIXT	LED178W	Non-Integrated Ballast LED, 178W, any bulb shape, any application	178W LED - Non-Int. Ballast	Electronic	N/A	N/A	178	15
LED179-FIXT	LED179W	Non-Integrated Ballast LED, 179W, any bulb shape, any application	179W LED - Non-Int. Ballast	Electronic	N/A	N/A	179	15
LED180-FIXT	LED180W	Non-Integrated Ballast LED, 180W, any bulb shape, any application	180W LED - Non-Int. Ballast	Electronic	N/A	N/A	180	15
LED181-FIXT	LED181W	Non-Integrated Ballast LED, 181W, any bulb shape, any application	181W LED - Non-Int. Ballast	Electronic	N/A	N/A	181	15
LED182-FIXT	LED182W	Non-Integrated Ballast LED, 182W, any bulb shape, any application	182W LED - Non-Int. Ballast	Electronic	N/A	N/A	182	15
LED183-FIXT	LED183W	Non-Integrated Ballast LED, 183W, any bulb shape, any application	183W LED - Non-Int. Ballast	Electronic	N/A	N/A	183	15
LED184-FIXT	LED184W	Non-Integrated Ballast LED, 184W, any bulb shape, any application	184W LED - Non-Int. Ballast	Electronic	N/A	N/A	184	15
LED185-FIXT	LED185W	Non-Integrated Ballast LED, 185W, any bulb shape, any application	185W LED - Non-Int. Ballast	Electronic	N/A	N/A	185	15
LED186-FIXT	LED186W	Non-Integrated Ballast LED, 186W, any bulb shape, any application	186W LED - Non-Int. Ballast	Electronic	N/A	N/A	186	15
LED187-FIXT	LED187W	Non-Integrated Ballast LED, 187W, any bulb shape, any application	187W LED - Non-Int. Ballast	Electronic	N/A	N/A	187	15
LED188-FIXT	LED188W	Non-Integrated Ballast LED, 188W, any bulb shape, any application	188W LED - Non-Int. Ballast	Electronic	N/A	N/A	188	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED189-FIXT	LED189W	Non-Integrated Ballast LED, 189W, any bulb shape, any application	189W LED - Non-Int. Ballast	Electronic	N/A	N/A	189	15
LED190-FIXT	LED190W	Non-Integrated Ballast LED, 190W, any bulb shape, any application	190W LED - Non-Int. Ballast	Electronic	N/A	N/A	190	15
LED191-FIXT	LED191W	Non-Integrated Ballast LED, 191W, any bulb shape, any application	191W LED - Non-Int. Ballast	Electronic	N/A	N/A	191	15
LED192-FIXT	LED192W	Non-Integrated Ballast LED, 192W, any bulb shape, any application	192W LED - Non-Int. Ballast	Electronic	N/A	N/A	192	15
LED193-FIXT	LED193W	Non-Integrated Ballast LED, 193W, any bulb shape, any application	193W LED - Non-Int. Ballast	Electronic	N/A	N/A	193	15
LED194-FIXT	LED194W	Non-Integrated Ballast LED, 194W, any bulb shape, any application	194W LED - Non-Int. Ballast	Electronic	N/A	N/A	194	15
LED195-FIXT	LED195W	Non-Integrated Ballast LED, 195W, any bulb shape, any application	195W LED - Non-Int. Ballast	Electronic	N/A	N/A	195	15
LED196-FIXT	LED196W	Non-Integrated Ballast LED, 196W, any bulb shape, any application	196W LED - Non-Int. Ballast	Electronic	N/A	N/A	196	15
LED197-FIXT	LED197W	Non-Integrated Ballast LED, 197W, any bulb shape, any application	197W LED - Non-Int. Ballast	Electronic	N/A	N/A	197	15
LED198-FIXT	LED198W	Non-Integrated Ballast LED, 198W, any bulb shape, any application	198W LED - Non-Int. Ballast	Electronic	N/A	N/A	198	15
LED199-FIXT	LED199W	Non-Integrated Ballast LED, 199W, any bulb shape, any application	199W LED - Non-Int. Ballast	Electronic	N/A	N/A	199	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED200-FIXT	LED200W	Non-Integrated Ballast LED, 200W, any bulb shape, any application	200W LED - Non-Int. Ballast	Electronic	N/A	N/A	200	15
LED201-FIXT	LED201W	Non-Integrated Ballast LED, 201W, any bulb shape, any application	201W LED - Non-Int. Ballast	Electronic	N/A	N/A	201	15
LED202-FIXT	LED202W	Non-Integrated Ballast LED, 202W, any bulb shape, any application	202W LED - Non-Int. Ballast	Electronic	N/A	N/A	202	15
LED203-FIXT	LED203W	Non-Integrated Ballast LED, 203W, any bulb shape, any application	203W LED - Non-Int. Ballast	Electronic	N/A	N/A	203	15
LED204-FIXT	LED204W	Non-Integrated Ballast LED, 204W, any bulb shape, any application	204W LED - Non-Int. Ballast	Electronic	N/A	N/A	204	15
LED205-FIXT	LED205W	Non-Integrated Ballast LED, 205W, any bulb shape, any application	205W LED - Non-Int. Ballast	Electronic	N/A	N/A	205	15
LED206-FIXT	LED206W	Non-Integrated Ballast LED, 206W, any bulb shape, any application	206W LED - Non-Int. Ballast	Electronic	N/A	N/A	206	15
LED207-FIXT	LED207W	Non-Integrated Ballast LED, 207W, any bulb shape, any application	207W LED - Non-Int. Ballast	Electronic	N/A	N/A	207	15
LED208-FIXT	LED208W	Non-Integrated Ballast LED, 208W, any bulb shape, any application	208W LED - Non-Int. Ballast	Electronic	N/A	N/A	208	15
LED209-FIXT	LED209W	Non-Integrated Ballast LED, 209W, any bulb shape, any application	209W LED - Non-Int. Ballast	Electronic	N/A	N/A	209	15
LED210-FIXT	LED210W	Non-Integrated Ballast LED, 210W, any bulb shape, any application	210W LED - Non-Int. Ballast	Electronic	N/A	N/A	210	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED211-FIXT	LED211W	Non-Integrated Ballast LED, 211W, any bulb shape, any application	211W LED - Non-Int. Ballast	Electronic	N/A	N/A	211	15
LED212-FIXT	LED212W	Non-Integrated Ballast LED, 212W, any bulb shape, any application	212W LED - Non-Int. Ballast	Electronic	N/A	N/A	212	15
LED213-FIXT	LED213W	Non-Integrated Ballast LED, 213W, any bulb shape, any application	213W LED - Non-Int. Ballast	Electronic	N/A	N/A	213	15
LED214-FIXT	LED214W	Non-Integrated Ballast LED, 214W, any bulb shape, any application	214W LED - Non-Int. Ballast	Electronic	N/A	N/A	214	15
LED215-FIXT	LED215W	Non-Integrated Ballast LED, 215W, any bulb shape, any application	215W LED - Non-Int. Ballast	Electronic	N/A	N/A	215	15
LED216-FIXT	LED216W	Non-Integrated Ballast LED, 216W, any bulb shape, any application	216W LED - Non-Int. Ballast	Electronic	N/A	N/A	216	15
LED217-FIXT	LED217W	Non-Integrated Ballast LED, 217W, any bulb shape, any application	217W LED - Non-Int. Ballast	Electronic	N/A	N/A	217	15
LED218-FIXT	LED218W	Non-Integrated Ballast LED, 218W, any bulb shape, any application	218W LED - Non-Int. Ballast	Electronic	N/A	N/A	218	15
LED219-FIXT	LED219W	Non-Integrated Ballast LED, 219W, any bulb shape, any application	219W LED - Non-Int. Ballast	Electronic	N/A	N/A	219	15
LED220-FIXT	LED220W	Non-Integrated Ballast LED, 220W, any bulb shape, any application	220W LED - Non-Int. Ballast	Electronic	N/A	N/A	220	15
LED221-FIXT	LED221W	Non-Integrated Ballast LED, 221W, any bulb shape, any application	221W LED - Non-Int. Ballast	Electronic	N/A	N/A	221	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED222-FIXT	LED222W	Non-Integrated Ballast LED, 222W, any bulb shape, any application	222W LED - Non-Int. Ballast	Electronic	N/A	N/A	222	15
LED223-FIXT	LED223W	Non-Integrated Ballast LED, 223W, any bulb shape, any application	223W LED - Non-Int. Ballast	Electronic	N/A	N/A	223	15
LED224-FIXT	LED224W	Non-Integrated Ballast LED, 224W, any bulb shape, any application	224W LED - Non-Int. Ballast	Electronic	N/A	N/A	224	15
LED225-FIXT	LED225W	Non-Integrated Ballast LED, 225W, any bulb shape, any application	225W LED - Non-Int. Ballast	Electronic	N/A	N/A	225	15
LED226-FIXT	LED226W	Non-Integrated Ballast LED, 226W, any bulb shape, any application	226W LED - Non-Int. Ballast	Electronic	N/A	N/A	226	15
LED227-FIXT	LED227W	Non-Integrated Ballast LED, 227W, any bulb shape, any application	227W LED - Non-Int. Ballast	Electronic	N/A	N/A	227	15
LED228-FIXT	LED228W	Non-Integrated Ballast LED, 228W, any bulb shape, any application	228W LED - Non-Int. Ballast	Electronic	N/A	N/A	228	15
LED229-FIXT	LED229W	Non-Integrated Ballast LED, 229W, any bulb shape, any application	229W LED - Non-Int. Ballast	Electronic	N/A	N/A	229	15
LED230-FIXT	LED230W	Non-Integrated Ballast LED, 230W, any bulb shape, any application	230W LED - Non-Int. Ballast	Electronic	N/A	N/A	230	15
LED231-FIXT	LED231W	Non-Integrated Ballast LED, 231W, any bulb shape, any application	231W LED - Non-Int. Ballast	Electronic	N/A	N/A	231	15
LED232-FIXT	LED232W	Non-Integrated Ballast LED, 232W, any bulb shape, any application	232W LED - Non-Int. Ballast	Electronic	N/A	N/A	232	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED233-FIXT	LED233W	Non-Integrated Ballast LED, 233W, any bulb shape, any application	233W LED - Non-Int. Ballast	Electronic	N/A	N/A	233	15
LED234-FIXT	LED234W	Non-Integrated Ballast LED, 234W, any bulb shape, any application	234W LED - Non-Int. Ballast	Electronic	N/A	N/A	234	15
LED235-FIXT	LED235W	Non-Integrated Ballast LED, 235W, any bulb shape, any application	235W LED - Non-Int. Ballast	Electronic	N/A	N/A	235	15
LED236-FIXT	LED236W	Non-Integrated Ballast LED, 236W, any bulb shape, any application	236W LED - Non-Int. Ballast	Electronic	N/A	N/A	236	15
LED237-FIXT	LED237W	Non-Integrated Ballast LED, 237W, any bulb shape, any application	237W LED - Non-Int. Ballast	Electronic	N/A	N/A	237	15
LED238-FIXT	LED238W	Non-Integrated Ballast LED, 238W, any bulb shape, any application	238W LED - Non-Int. Ballast	Electronic	N/A	N/A	238	15
LED239-FIXT	LED239W	Non-Integrated Ballast LED, 239W, any bulb shape, any application	239W LED - Non-Int. Ballast	Electronic	N/A	N/A	239	15
LED240-FIXT	LED240W	Non-Integrated Ballast LED, 240W, any bulb shape, any application	240W LED - Non-Int. Ballast	Electronic	N/A	N/A	240	15
LED241-FIXT	LED241W	Non-Integrated Ballast LED, 241W, any bulb shape, any application	241W LED - Non-Int. Ballast	Electronic	N/A	N/A	241	15
LED242-FIXT	LED242W	Non-Integrated Ballast LED, 242W, any bulb shape, any application	242W LED - Non-Int. Ballast	Electronic	N/A	N/A	242	15
LED243-FIXT	LED243W	Non-Integrated Ballast LED, 243W, any bulb shape, any application	243W LED - Non-Int. Ballast	Electronic	N/A	N/A	243	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED244-FIXT	LED244W	Non-Integrated Ballast LED, 244W, any bulb shape, any application	244W LED - Non-Int. Ballast	Electronic	N/A	N/A	244	15
LED245-FIXT	LED245W	Non-Integrated Ballast LED, 245W, any bulb shape, any application	245W LED - Non-Int. Ballast	Electronic	N/A	N/A	245	15
LED246-FIXT	LED246W	Non-Integrated Ballast LED, 246W, any bulb shape, any application	246W LED - Non-Int. Ballast	Electronic	N/A	N/A	246	15
LED247-FIXT	LED247W	Non-Integrated Ballast LED, 247W, any bulb shape, any application	247W LED - Non-Int. Ballast	Electronic	N/A	N/A	247	15
LED248-FIXT	LED248W	Non-Integrated Ballast LED, 248W, any bulb shape, any application	248W LED - Non-Int. Ballast	Electronic	N/A	N/A	248	15
LED249-FIXT	LED249W	Non-Integrated Ballast LED, 249W, any bulb shape, any application	249W LED - Non-Int. Ballast	Electronic	N/A	N/A	249	15
LED250-FIXT	LED250W	Non-Integrated Ballast LED, 250W, any bulb shape, any application	250W LED - Non-Int. Ballast	Electronic	N/A	N/A	250	15
LED251-FIXT	LED251W	Non-Integrated Ballast LED, 251W, any bulb shape, any application	251W LED - Non-Int. Ballast	Electronic	N/A	N/A	251	15
LED252-FIXT	LED252W	Non-Integrated Ballast LED, 252W, any bulb shape, any application	252W LED - Non-Int. Ballast	Electronic	N/A	N/A	252	15
LED253-FIXT	LED253W	Non-Integrated Ballast LED, 253W, any bulb shape, any application	253W LED - Non-Int. Ballast	Electronic	N/A	N/A	253	15
LED254-FIXT	LED254W	Non-Integrated Ballast LED, 254W, any bulb shape, any application	254W LED - Non-Int. Ballast	Electronic	N/A	N/A	254	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED255-FIXT	LED255W	Non-Integrated Ballast LED, 255W, any bulb shape, any application	255W LED - Non-Int. Ballast	Electronic	N/A	N/A	255	15
LED256-FIXT	LED256W	Non-Integrated Ballast LED, 256W, any bulb shape, any application	256W LED - Non-Int. Ballast	Electronic	N/A	N/A	256	15
LED257-FIXT	LED257W	Non-Integrated Ballast LED, 257W, any bulb shape, any application	257W LED - Non-Int. Ballast	Electronic	N/A	N/A	257	15
LED258-FIXT	LED258W	Non-Integrated Ballast LED, 258W, any bulb shape, any application	258W LED - Non-Int. Ballast	Electronic	N/A	N/A	258	15
LED259-FIXT	LED259W	Non-Integrated Ballast LED, 259W, any bulb shape, any application	259W LED - Non-Int. Ballast	Electronic	N/A	N/A	259	15
LED260-FIXT	LED260W	Non-Integrated Ballast LED, 260W, any bulb shape, any application	260W LED - Non-Int. Ballast	Electronic	N/A	N/A	260	15
LED261-FIXT	LED261W	Non-Integrated Ballast LED, 261W, any bulb shape, any application	261W LED - Non-Int. Ballast	Electronic	N/A	N/A	261	15
LED262-FIXT	LED262W	Non-Integrated Ballast LED, 262W, any bulb shape, any application	262W LED - Non-Int. Ballast	Electronic	N/A	N/A	262	15
LED263-FIXT	LED263W	Non-Integrated Ballast LED, 263W, any bulb shape, any application	263W LED - Non-Int. Ballast	Electronic	N/A	N/A	263	15
LED264-FIXT	LED264W	Non-Integrated Ballast LED, 264W, any bulb shape, any application	264W LED - Non-Int. Ballast	Electronic	N/A	N/A	264	15
LED265-FIXT	LED265W	Non-Integrated Ballast LED, 265W, any bulb shape, any application	265W LED - Non-Int. Ballast	Electronic	N/A	N/A	265	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED266-FIXT	LED266W	Non-Integrated Ballast LED, 266W, any bulb shape, any application	266W LED - Non-Int. Ballast	Electronic	N/A	N/A	266	15
LED267-FIXT	LED267W	Non-Integrated Ballast LED, 267W, any bulb shape, any application	267W LED - Non-Int. Ballast	Electronic	N/A	N/A	267	15
LED268-FIXT	LED268W	Non-Integrated Ballast LED, 268W, any bulb shape, any application	268W LED - Non-Int. Ballast	Electronic	N/A	N/A	268	15
LED269-FIXT	LED269W	Non-Integrated Ballast LED, 269W, any bulb shape, any application	269W LED - Non-Int. Ballast	Electronic	N/A	N/A	269	15
LED270-FIXT	LED270W	Non-Integrated Ballast LED, 270W, any bulb shape, any application	270W LED - Non-Int. Ballast	Electronic	N/A	N/A	270	15
LED271-FIXT	LED271W	Non-Integrated Ballast LED, 271W, any bulb shape, any application	271W LED - Non-Int. Ballast	Electronic	N/A	N/A	271	15
LED272-FIXT	LED272W	Non-Integrated Ballast LED, 272W, any bulb shape, any application	272W LED - Non-Int. Ballast	Electronic	N/A	N/A	272	15
LED273-FIXT	LED273W	Non-Integrated Ballast LED, 273W, any bulb shape, any application	273W LED - Non-Int. Ballast	Electronic	N/A	N/A	273	15
LED274-FIXT	LED274W	Non-Integrated Ballast LED, 274W, any bulb shape, any application	274W LED - Non-Int. Ballast	Electronic	N/A	N/A	274	15
LED275-FIXT	LED275W	Non-Integrated Ballast LED, 275W, any bulb shape, any application	275W LED - Non-Int. Ballast	Electronic	N/A	N/A	275	15
LED276-FIXT	LED276W	Non-Integrated Ballast LED, 276W, any bulb shape, any application	276W LED - Non-Int. Ballast	Electronic	N/A	N/A	276	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED277-FIXT	LED277W	Non-Integrated Ballast LED, 277W, any bulb shape, any application	277W LED - Non-Int. Ballast	Electronic	N/A	N/A	277	15
LED278-FIXT	LED278W	Non-Integrated Ballast LED, 278W, any bulb shape, any application	278W LED - Non-Int. Ballast	Electronic	N/A	N/A	278	15
LED279-FIXT	LED279W	Non-Integrated Ballast LED, 279W, any bulb shape, any application	279W LED - Non-Int. Ballast	Electronic	N/A	N/A	279	15
LED280-FIXT	LED280W	Non-Integrated Ballast LED, 280W, any bulb shape, any application	280W LED - Non-Int. Ballast	Electronic	N/A	N/A	280	15
LED281-FIXT	LED281W	Non-Integrated Ballast LED, 281W, any bulb shape, any application	281W LED - Non-Int. Ballast	Electronic	N/A	N/A	281	15
LED282-FIXT	LED282W	Non-Integrated Ballast LED, 282W, any bulb shape, any application	282W LED - Non-Int. Ballast	Electronic	N/A	N/A	282	15
LED283-FIXT	LED283W	Non-Integrated Ballast LED, 283W, any bulb shape, any application	283W LED - Non-Int. Ballast	Electronic	N/A	N/A	283	15
LED284-FIXT	LED284W	Non-Integrated Ballast LED, 284W, any bulb shape, any application	284W LED - Non-Int. Ballast	Electronic	N/A	N/A	284	15
LED285-FIXT	LED285W	Non-Integrated Ballast LED, 285W, any bulb shape, any application	285W LED - Non-Int. Ballast	Electronic	N/A	N/A	285	15
LED286-FIXT	LED286W	Non-Integrated Ballast LED, 286W, any bulb shape, any application	286W LED - Non-Int. Ballast	Electronic	N/A	N/A	286	15
LED287-FIXT	LED287W	Non-Integrated Ballast LED, 287W, any bulb shape, any application	287W LED - Non-Int. Ballast	Electronic	N/A	N/A	287	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED288-FIXT	LED288W	Non-Integrated Ballast LED, 288W, any bulb shape, any application	288W LED - Non-Int. Ballast	Electronic	N/A	N/A	288	15
LED289-FIXT	LED289W	Non-Integrated Ballast LED, 289W, any bulb shape, any application	289W LED - Non-Int. Ballast	Electronic	N/A	N/A	289	15
LED290-FIXT	LED290W	Non-Integrated Ballast LED, 290W, any bulb shape, any application	290W LED - Non-Int. Ballast	Electronic	N/A	N/A	290	15
LED291-FIXT	LED291W	Non-Integrated Ballast LED, 291W, any bulb shape, any application	291W LED - Non-Int. Ballast	Electronic	N/A	N/A	291	15
LED292-FIXT	LED292W	Non-Integrated Ballast LED, 292W, any bulb shape, any application	292W LED - Non-Int. Ballast	Electronic	N/A	N/A	292	15
LED293-FIXT	LED293W	Non-Integrated Ballast LED, 293W, any bulb shape, any application	293W LED - Non-Int. Ballast	Electronic	N/A	N/A	293	15
LED294-FIXT	LED294W	Non-Integrated Ballast LED, 294W, any bulb shape, any application	294W LED - Non-Int. Ballast	Electronic	N/A	N/A	294	15
LED295-FIXT	LED295W	Non-Integrated Ballast LED, 295W, any bulb shape, any application	295W LED - Non-Int. Ballast	Electronic	N/A	N/A	295	15
LED296-FIXT	LED296W	Non-Integrated Ballast LED, 296W, any bulb shape, any application	296W LED - Non-Int. Ballast	Electronic	N/A	N/A	296	15
LED297-FIXT	LED297W	Non-Integrated Ballast LED, 297W, any bulb shape, any application	297W LED - Non-Int. Ballast	Electronic	N/A	N/A	297	15
LED298-FIXT	LED298W	Non-Integrated Ballast LED, 298W, any bulb shape, any application	298W LED - Non-Int. Ballast	Electronic	N/A	N/A	298	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED299-FIXT	LED299W	Non-Integrated Ballast LED, 299W, any bulb shape, any application	299W LED - Non-Int. Ballast	Electronic	N/A	N/A	299	15
LED300-FIXT	LED300W	Non-Integrated Ballast LED, 300W, any bulb shape, any application	300W LED - Non-Int. Ballast	Electronic	N/A	N/A	300	15
LED301-FIXT	LED301W	Non-Integrated Ballast LED, 301W, any bulb shape, any application	301W LED - Non-Int. Ballast	Electronic	N/A	N/A	301	15
LED302-FIXT	LED302W	Non-Integrated Ballast LED, 302W, any bulb shape, any application	302W LED - Non-Int. Ballast	Electronic	N/A	N/A	302	15
LED303-FIXT	LED303W	Non-Integrated Ballast LED, 303W, any bulb shape, any application	303W LED - Non-Int. Ballast	Electronic	N/A	N/A	303	15
LED304-FIXT	LED304W	Non-Integrated Ballast LED, 304W, any bulb shape, any application	304W LED - Non-Int. Ballast	Electronic	N/A	N/A	304	15
LED305-FIXT	LED305W	Non-Integrated Ballast LED, 305W, any bulb shape, any application	305W LED - Non-Int. Ballast	Electronic	N/A	N/A	305	15
LED306-FIXT	LED306W	Non-Integrated Ballast LED, 306W, any bulb shape, any application	306W LED - Non-Int. Ballast	Electronic	N/A	N/A	306	15
LED307-FIXT	LED307W	Non-Integrated Ballast LED, 307W, any bulb shape, any application	307W LED - Non-Int. Ballast	Electronic	N/A	N/A	307	15
LED308-FIXT	LED308W	Non-Integrated Ballast LED, 308W, any bulb shape, any application	308W LED - Non-Int. Ballast	Electronic	N/A	N/A	308	15
LED309-FIXT	LED309W	Non-Integrated Ballast LED, 309W, any bulb shape, any application	309W LED - Non-Int. Ballast	Electronic	N/A	N/A	309	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED310-FIXT	LED310W	Non-Integrated Ballast LED, 310W, any bulb shape, any application	310W LED - Non-Int. Ballast	Electronic	N/A	N/A	310	15
LED311-FIXT	LED311W	Non-Integrated Ballast LED, 311W, any bulb shape, any application	311W LED - Non-Int. Ballast	Electronic	N/A	N/A	311	15
LED312-FIXT	LED312W	Non-Integrated Ballast LED, 312W, any bulb shape, any application	312W LED - Non-Int. Ballast	Electronic	N/A	N/A	312	15
LED313-FIXT	LED313W	Non-Integrated Ballast LED, 313W, any bulb shape, any application	313W LED - Non-Int. Ballast	Electronic	N/A	N/A	313	15
LED314-FIXT	LED314W	Non-Integrated Ballast LED, 314W, any bulb shape, any application	314W LED - Non-Int. Ballast	Electronic	N/A	N/A	314	15
LED315-FIXT	LED315W	Non-Integrated Ballast LED, 315W, any bulb shape, any application	315W LED - Non-Int. Ballast	Electronic	N/A	N/A	315	15
LED316-FIXT	LED316W	Non-Integrated Ballast LED, 316W, any bulb shape, any application	316W LED - Non-Int. Ballast	Electronic	N/A	N/A	316	15
LED317-FIXT	LED317W	Non-Integrated Ballast LED, 317W, any bulb shape, any application	317W LED - Non-Int. Ballast	Electronic	N/A	N/A	317	15
LED318-FIXT	LED318W	Non-Integrated Ballast LED, 318W, any bulb shape, any application	318W LED - Non-Int. Ballast	Electronic	N/A	N/A	318	15
LED319-FIXT	LED319W	Non-Integrated Ballast LED, 319W, any bulb shape, any application	319W LED - Non-Int. Ballast	Electronic	N/A	N/A	319	15
LED320-FIXT	LED320W	Non-Integrated Ballast LED, 320W, any bulb shape, any application	320W LED - Non-Int. Ballast	Electronic	N/A	N/A	320	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED321-FIXT	LED321W	Non-Integrated Ballast LED, 321W, any bulb shape, any application	321W LED - Non-Int. Ballast	Electronic	N/A	N/A	321	15
LED322-FIXT	LED322W	Non-Integrated Ballast LED, 322W, any bulb shape, any application	322W LED - Non-Int. Ballast	Electronic	N/A	N/A	322	15
LED323-FIXT	LED323W	Non-Integrated Ballast LED, 323W, any bulb shape, any application	323W LED - Non-Int. Ballast	Electronic	N/A	N/A	323	15
LED324-FIXT	LED324W	Non-Integrated Ballast LED, 324W, any bulb shape, any application	324W LED - Non-Int. Ballast	Electronic	N/A	N/A	324	15
LED325-FIXT	LED325W	Non-Integrated Ballast LED, 325W, any bulb shape, any application	325W LED - Non-Int. Ballast	Electronic	N/A	N/A	325	15
LED326-FIXT	LED326W	Non-Integrated Ballast LED, 326W, any bulb shape, any application	326W LED - Non-Int. Ballast	Electronic	N/A	N/A	326	15
LED327-FIXT	LED327W	Non-Integrated Ballast LED, 327W, any bulb shape, any application	327W LED - Non-Int. Ballast	Electronic	N/A	N/A	327	15
LED328-FIXT	LED328W	Non-Integrated Ballast LED, 328W, any bulb shape, any application	328W LED - Non-Int. Ballast	Electronic	N/A	N/A	328	15
LED329-FIXT	LED329W	Non-Integrated Ballast LED, 329W, any bulb shape, any application	329W LED - Non-Int. Ballast	Electronic	N/A	N/A	329	15
LED330-FIXT	LED330W	Non-Integrated Ballast LED, 330W, any bulb shape, any application	330W LED - Non-Int. Ballast	Electronic	N/A	N/A	330	15
LED331-FIXT	LED331W	Non-Integrated Ballast LED, 331W, any bulb shape, any application	331W LED - Non-Int. Ballast	Electronic	N/A	N/A	331	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED332-FIXT	LED332W	Non-Integrated Ballast LED, 332W, any bulb shape, any application	332W LED - Non-Int. Ballast	Electronic	N/A	N/A	332	15
LED333-FIXT	LED333W	Non-Integrated Ballast LED, 333W, any bulb shape, any application	333W LED - Non-Int. Ballast	Electronic	N/A	N/A	333	15
LED334-FIXT	LED334W	Non-Integrated Ballast LED, 334W, any bulb shape, any application	334W LED - Non-Int. Ballast	Electronic	N/A	N/A	334	15
LED335-FIXT	LED335W	Non-Integrated Ballast LED, 335W, any bulb shape, any application	335W LED - Non-Int. Ballast	Electronic	N/A	N/A	335	15
LED336-FIXT	LED336W	Non-Integrated Ballast LED, 336W, any bulb shape, any application	336W LED - Non-Int. Ballast	Electronic	N/A	N/A	336	15
LED337-FIXT	LED337W	Non-Integrated Ballast LED, 337W, any bulb shape, any application	337W LED - Non-Int. Ballast	Electronic	N/A	N/A	337	15
LED338-FIXT	LED338W	Non-Integrated Ballast LED, 338W, any bulb shape, any application	338W LED - Non-Int. Ballast	Electronic	N/A	N/A	338	15
LED339-FIXT	LED339W	Non-Integrated Ballast LED, 339W, any bulb shape, any application	339W LED - Non-Int. Ballast	Electronic	N/A	N/A	339	15
LED340-FIXT	LED340W	Non-Integrated Ballast LED, 340W, any bulb shape, any application	340W LED - Non-Int. Ballast	Electronic	N/A	N/A	340	15
LED341-FIXT	LED341W	Non-Integrated Ballast LED, 341W, any bulb shape, any application	341W LED - Non-Int. Ballast	Electronic	N/A	N/A	341	15
LED342-FIXT	LED342W	Non-Integrated Ballast LED, 342W, any bulb shape, any application	342W LED - Non-Int. Ballast	Electronic	N/A	N/A	342	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED343-FIXT	LED343W	Non-Integrated Ballast LED, 343W, any bulb shape, any application	343W LED - Non-Int. Ballast	Electronic	N/A	N/A	343	15
LED344-FIXT	LED344W	Non-Integrated Ballast LED, 344W, any bulb shape, any application	344W LED - Non-Int. Ballast	Electronic	N/A	N/A	344	15
LED345-FIXT	LED345W	Non-Integrated Ballast LED, 345W, any bulb shape, any application	345W LED - Non-Int. Ballast	Electronic	N/A	N/A	345	15
LED346-FIXT	LED346W	Non-Integrated Ballast LED, 346W, any bulb shape, any application	346W LED - Non-Int. Ballast	Electronic	N/A	N/A	346	15
LED347-FIXT	LED347W	Non-Integrated Ballast LED, 347W, any bulb shape, any application	347W LED - Non-Int. Ballast	Electronic	N/A	N/A	347	15
LED348-FIXT	LED348W	Non-Integrated Ballast LED, 348W, any bulb shape, any application	348W LED - Non-Int. Ballast	Electronic	N/A	N/A	348	15
LED349-FIXT	LED349W	Non-Integrated Ballast LED, 349W, any bulb shape, any application	349W LED - Non-Int. Ballast	Electronic	N/A	N/A	349	15
LED350-FIXT	LED350W	Non-Integrated Ballast LED, 350W, any bulb shape, any application	350W LED - Non-Int. Ballast	Electronic	N/A	N/A	350	15
LED351-FIXT	LED351W	Non-Integrated Ballast LED, 351W, any bulb shape, any application	351W LED - Non-Int. Ballast	Electronic	N/A	N/A	351	15
LED352-FIXT	LED352W	Non-Integrated Ballast LED, 352W, any bulb shape, any application	352W LED - Non-Int. Ballast	Electronic	N/A	N/A	352	15
LED353-FIXT	LED353W	Non-Integrated Ballast LED, 353W, any bulb shape, any application	353W LED - Non-Int. Ballast	Electronic	N/A	N/A	353	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED354-FIXT	LED354W	Non-Integrated Ballast LED, 354W, any bulb shape, any application	354W LED - Non-Int. Ballast	Electronic	N/A	N/A	354	15
LED355-FIXT	LED355W	Non-Integrated Ballast LED, 355W, any bulb shape, any application	355W LED - Non-Int. Ballast	Electronic	N/A	N/A	355	15
LED356-FIXT	LED356W	Non-Integrated Ballast LED, 356W, any bulb shape, any application	356W LED - Non-Int. Ballast	Electronic	N/A	N/A	356	15
LED357-FIXT	LED357W	Non-Integrated Ballast LED, 357W, any bulb shape, any application	357W LED - Non-Int. Ballast	Electronic	N/A	N/A	357	15
LED358-FIXT	LED358W	Non-Integrated Ballast LED, 358W, any bulb shape, any application	358W LED - Non-Int. Ballast	Electronic	N/A	N/A	358	15
LED359-FIXT	LED359W	Non-Integrated Ballast LED, 359W, any bulb shape, any application	359W LED - Non-Int. Ballast	Electronic	N/A	N/A	359	15
LED360-FIXT	LED360W	Non-Integrated Ballast LED, 360W, any bulb shape, any application	360W LED - Non-Int. Ballast	Electronic	N/A	N/A	360	15
LED361-FIXT	LED361W	Non-Integrated Ballast LED, 361W, any bulb shape, any application	361W LED - Non-Int. Ballast	Electronic	N/A	N/A	361	15
LED362-FIXT	LED362W	Non-Integrated Ballast LED, 362W, any bulb shape, any application	362W LED - Non-Int. Ballast	Electronic	N/A	N/A	362	15
LED363-FIXT	LED363W	Non-Integrated Ballast LED, 363W, any bulb shape, any application	363W LED - Non-Int. Ballast	Electronic	N/A	N/A	363	15
LED364-FIXT	LED364W	Non-Integrated Ballast LED, 364W, any bulb shape, any application	364W LED - Non-Int. Ballast	Electronic	N/A	N/A	364	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED365-FIXT	LED365W	Non-Integrated Ballast LED, 365W, any bulb shape, any application	365W LED - Non-Int. Ballast	Electronic	N/A	N/A	365	15
LED366-FIXT	LED366W	Non-Integrated Ballast LED, 366W, any bulb shape, any application	366W LED - Non-Int. Ballast	Electronic	N/A	N/A	366	15
LED367-FIXT	LED367W	Non-Integrated Ballast LED, 367W, any bulb shape, any application	367W LED - Non-Int. Ballast	Electronic	N/A	N/A	367	15
LED368-FIXT	LED368W	Non-Integrated Ballast LED, 368W, any bulb shape, any application	368W LED - Non-Int. Ballast	Electronic	N/A	N/A	368	15
LED369-FIXT	LED369W	Non-Integrated Ballast LED, 369W, any bulb shape, any application	369W LED - Non-Int. Ballast	Electronic	N/A	N/A	369	15
LED370-FIXT	LED370W	Non-Integrated Ballast LED, 370W, any bulb shape, any application	370W LED - Non-Int. Ballast	Electronic	N/A	N/A	370	15
LED371-FIXT	LED371W	Non-Integrated Ballast LED, 371W, any bulb shape, any application	371W LED - Non-Int. Ballast	Electronic	N/A	N/A	371	15
LED372-FIXT	LED372W	Non-Integrated Ballast LED, 372W, any bulb shape, any application	372W LED - Non-Int. Ballast	Electronic	N/A	N/A	372	15
LED373-FIXT	LED373W	Non-Integrated Ballast LED, 373W, any bulb shape, any application	373W LED - Non-Int. Ballast	Electronic	N/A	N/A	373	15
LED374-FIXT	LED374W	Non-Integrated Ballast LED, 374W, any bulb shape, any application	374W LED - Non-Int. Ballast	Electronic	N/A	N/A	374	15
LED375-FIXT	LED375W	Non-Integrated Ballast LED, 375W, any bulb shape, any application	375W LED - Non-Int. Ballast	Electronic	N/A	N/A	375	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED376-FIXT	LED376W	Non-Integrated Ballast LED, 376W, any bulb shape, any application	376W LED - Non-Int. Ballast	Electronic	N/A	N/A	376	15
LED377-FIXT	LED377W	Non-Integrated Ballast LED, 377W, any bulb shape, any application	377W LED - Non-Int. Ballast	Electronic	N/A	N/A	377	15
LED378-FIXT	LED378W	Non-Integrated Ballast LED, 378W, any bulb shape, any application	378W LED - Non-Int. Ballast	Electronic	N/A	N/A	378	15
LED379-FIXT	LED379W	Non-Integrated Ballast LED, 379W, any bulb shape, any application	379W LED - Non-Int. Ballast	Electronic	N/A	N/A	379	15
LED380-FIXT	LED380W	Non-Integrated Ballast LED, 380W, any bulb shape, any application	380W LED - Non-Int. Ballast	Electronic	N/A	N/A	380	15
LED381-FIXT	LED381W	Non-Integrated Ballast LED, 381W, any bulb shape, any application	381W LED - Non-Int. Ballast	Electronic	N/A	N/A	381	15
LED382-FIXT	LED382W	Non-Integrated Ballast LED, 382W, any bulb shape, any application	382W LED - Non-Int. Ballast	Electronic	N/A	N/A	382	15
LED383-FIXT	LED383W	Non-Integrated Ballast LED, 383W, any bulb shape, any application	383W LED - Non-Int. Ballast	Electronic	N/A	N/A	383	15
LED384-FIXT	LED384W	Non-Integrated Ballast LED, 384W, any bulb shape, any application	384W LED - Non-Int. Ballast	Electronic	N/A	N/A	384	15
LED385-FIXT	LED385W	Non-Integrated Ballast LED, 385W, any bulb shape, any application	385W LED - Non-Int. Ballast	Electronic	N/A	N/A	385	15
LED386-FIXT	LED386W	Non-Integrated Ballast LED, 386W, any bulb shape, any application	386W LED - Non-Int. Ballast	Electronic	N/A	N/A	386	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED387-FIXT	LED387W	Non-Integrated Ballast LED, 387W, any bulb shape, any application	387W LED - Non-Int. Ballast	Electronic	N/A	N/A	387	15
LED388-FIXT	LED388W	Non-Integrated Ballast LED, 388W, any bulb shape, any application	388W LED - Non-Int. Ballast	Electronic	N/A	N/A	388	15
LED389-FIXT	LED389W	Non-Integrated Ballast LED, 389W, any bulb shape, any application	389W LED - Non-Int. Ballast	Electronic	N/A	N/A	389	15
LED390-FIXT	LED390W	Non-Integrated Ballast LED, 390W, any bulb shape, any application	390W LED - Non-Int. Ballast	Electronic	N/A	N/A	390	15
LED391-FIXT	LED391W	Non-Integrated Ballast LED, 391W, any bulb shape, any application	391W LED - Non-Int. Ballast	Electronic	N/A	N/A	391	15
LED392-FIXT	LED392W	Non-Integrated Ballast LED, 392W, any bulb shape, any application	392W LED - Non-Int. Ballast	Electronic	N/A	N/A	392	15
LED393-FIXT	LED393W	Non-Integrated Ballast LED, 393W, any bulb shape, any application	393W LED - Non-Int. Ballast	Electronic	N/A	N/A	393	15
LED394-FIXT	LED394W	Non-Integrated Ballast LED, 394W, any bulb shape, any application	394W LED - Non-Int. Ballast	Electronic	N/A	N/A	394	15
LED395-FIXT	LED395W	Non-Integrated Ballast LED, 395W, any bulb shape, any application	395W LED - Non-Int. Ballast	Electronic	N/A	N/A	395	15
LED396-FIXT	LED396W	Non-Integrated Ballast LED, 396W, any bulb shape, any application	396W LED - Non-Int. Ballast	Electronic	N/A	N/A	396	15
LED397-FIXT	LED397W	Non-Integrated Ballast LED, 397W, any bulb shape, any application	397W LED - Non-Int. Ballast	Electronic	N/A	N/A	397	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED398-FIXT	LED398W	Non-Integrated Ballast LED, 398W, any bulb shape, any application	398W LED - Non-Int. Ballast	Electronic	N/A	N/A	398	15
LED399-FIXT	LED399W	Non-Integrated Ballast LED, 399W, any bulb shape, any application	399W LED - Non-Int. Ballast	Electronic	N/A	N/A	399	15
LED400-FIXT	LED400W	Non-Integrated Ballast LED, 400W, any bulb shape, any application	400W LED - Non-Int. Ballast	Electronic	N/A	N/A	400	15
LED401-FIXT	LED401W	Non-Integrated Ballast LED, 401W, any bulb shape, any application	401W LED - Non-Int. Ballast	Electronic	N/A	N/A	401	15
LED402-FIXT	LED402W	Non-Integrated Ballast LED, 402W, any bulb shape, any application	402W LED - Non-Int. Ballast	Electronic	N/A	N/A	402	15
LED403-FIXT	LED403W	Non-Integrated Ballast LED, 403W, any bulb shape, any application	403W LED - Non-Int. Ballast	Electronic	N/A	N/A	403	15
LED404-FIXT	LED404W	Non-Integrated Ballast LED, 404W, any bulb shape, any application	404W LED - Non-Int. Ballast	Electronic	N/A	N/A	404	15
LED405-FIXT	LED405W	Non-Integrated Ballast LED, 405W, any bulb shape, any application	405W LED - Non-Int. Ballast	Electronic	N/A	N/A	405	15
LED406-FIXT	LED406W	Non-Integrated Ballast LED, 406W, any bulb shape, any application	406W LED - Non-Int. Ballast	Electronic	N/A	N/A	406	15
LED407-FIXT	LED407W	Non-Integrated Ballast LED, 407W, any bulb shape, any application	407W LED - Non-Int. Ballast	Electronic	N/A	N/A	407	15
LED408-FIXT	LED408W	Non-Integrated Ballast LED, 408W, any bulb shape, any application	408W LED - Non-Int. Ballast	Electronic	N/A	N/A	408	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED409-FIXT	LED409W	Non-Integrated Ballast LED, 409W, any bulb shape, any application	409W LED - Non-Int. Ballast	Electronic	N/A	N/A	409	15
LED410-FIXT	LED410W	Non-Integrated Ballast LED, 410W, any bulb shape, any application	410W LED - Non-Int. Ballast	Electronic	N/A	N/A	410	15
LED411-FIXT	LED411W	Non-Integrated Ballast LED, 411W, any bulb shape, any application	411W LED - Non-Int. Ballast	Electronic	N/A	N/A	411	15
LED412-FIXT	LED412W	Non-Integrated Ballast LED, 412W, any bulb shape, any application	412W LED - Non-Int. Ballast	Electronic	N/A	N/A	412	15
LED413-FIXT	LED413W	Non-Integrated Ballast LED, 413W, any bulb shape, any application	413W LED - Non-Int. Ballast	Electronic	N/A	N/A	413	15
LED414-FIXT	LED414W	Non-Integrated Ballast LED, 414W, any bulb shape, any application	414W LED - Non-Int. Ballast	Electronic	N/A	N/A	414	15
LED415-FIXT	LED415W	Non-Integrated Ballast LED, 415W, any bulb shape, any application	415W LED - Non-Int. Ballast	Electronic	N/A	N/A	415	15
LED416-FIXT	LED416W	Non-Integrated Ballast LED, 416W, any bulb shape, any application	416W LED - Non-Int. Ballast	Electronic	N/A	N/A	416	15
LED417-FIXT	LED417W	Non-Integrated Ballast LED, 417W, any bulb shape, any application	417W LED - Non-Int. Ballast	Electronic	N/A	N/A	417	15
LED418-FIXT	LED418W	Non-Integrated Ballast LED, 418W, any bulb shape, any application	418W LED - Non-Int. Ballast	Electronic	N/A	N/A	418	15
LED419-FIXT	LED419W	Non-Integrated Ballast LED, 419W, any bulb shape, any application	419W LED - Non-Int. Ballast	Electronic	N/A	N/A	419	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED420-FIXT	LED420W	Non-Integrated Ballast LED, 420W, any bulb shape, any application	420W LED - Non-Int. Ballast	Electronic	N/A	N/A	420	15
LED421-FIXT	LED421W	Non-Integrated Ballast LED, 421W, any bulb shape, any application	421W LED - Non-Int. Ballast	Electronic	N/A	N/A	421	15
LED422-FIXT	LED422W	Non-Integrated Ballast LED, 422W, any bulb shape, any application	422W LED - Non-Int. Ballast	Electronic	N/A	N/A	422	15
LED423-FIXT	LED423W	Non-Integrated Ballast LED, 423W, any bulb shape, any application	423W LED - Non-Int. Ballast	Electronic	N/A	N/A	423	15
LED424-FIXT	LED424W	Non-Integrated Ballast LED, 424W, any bulb shape, any application	424W LED - Non-Int. Ballast	Electronic	N/A	N/A	424	15
LED425-FIXT	LED425W	Non-Integrated Ballast LED, 425W, any bulb shape, any application	425W LED - Non-Int. Ballast	Electronic	N/A	N/A	425	15
LED426-FIXT	LED426W	Non-Integrated Ballast LED, 426W, any bulb shape, any application	426W LED - Non-Int. Ballast	Electronic	N/A	N/A	426	15
LED427-FIXT	LED427W	Non-Integrated Ballast LED, 427W, any bulb shape, any application	427W LED - Non-Int. Ballast	Electronic	N/A	N/A	427	15
LED428-FIXT	LED428W	Non-Integrated Ballast LED, 428W, any bulb shape, any application	428W LED - Non-Int. Ballast	Electronic	N/A	N/A	428	15
LED429-FIXT	LED429W	Non-Integrated Ballast LED, 429W, any bulb shape, any application	429W LED - Non-Int. Ballast	Electronic	N/A	N/A	429	15
LED430-FIXT	LED430W	Non-Integrated Ballast LED, 430W, any bulb shape, any application	430W LED - Non-Int. Ballast	Electronic	N/A	N/A	430	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED431-FIXT	LED431W	Non-Integrated Ballast LED, 431W, any bulb shape, any application	431W LED - Non-Int. Ballast	Electronic	N/A	N/A	431	15
LED432-FIXT	LED432W	Non-Integrated Ballast LED, 432W, any bulb shape, any application	432W LED - Non-Int. Ballast	Electronic	N/A	N/A	432	15
LED433-FIXT	LED433W	Non-Integrated Ballast LED, 433W, any bulb shape, any application	433W LED - Non-Int. Ballast	Electronic	N/A	N/A	433	15
LED434-FIXT	LED434W	Non-Integrated Ballast LED, 434W, any bulb shape, any application	434W LED - Non-Int. Ballast	Electronic	N/A	N/A	434	15
LED435-FIXT	LED435W	Non-Integrated Ballast LED, 435W, any bulb shape, any application	435W LED - Non-Int. Ballast	Electronic	N/A	N/A	435	15
LED436-FIXT	LED436W	Non-Integrated Ballast LED, 436W, any bulb shape, any application	436W LED - Non-Int. Ballast	Electronic	N/A	N/A	436	15
LED437-FIXT	LED437W	Non-Integrated Ballast LED, 437W, any bulb shape, any application	437W LED - Non-Int. Ballast	Electronic	N/A	N/A	437	15
LED438-FIXT	LED438W	Non-Integrated Ballast LED, 438W, any bulb shape, any application	438W LED - Non-Int. Ballast	Electronic	N/A	N/A	438	15
LED439-FIXT	LED439W	Non-Integrated Ballast LED, 439W, any bulb shape, any application	439W LED - Non-Int. Ballast	Electronic	N/A	N/A	439	15
LED440-FIXT	LED440W	Non-Integrated Ballast LED, 440W, any bulb shape, any application	440W LED - Non-Int. Ballast	Electronic	N/A	N/A	440	15
LED441-FIXT	LED441W	Non-Integrated Ballast LED, 441W, any bulb shape, any application	441W LED - Non-Int. Ballast	Electronic	N/A	N/A	441	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED442-FIXT	LED442W	Non-Integrated Ballast LED, 442W, any bulb shape, any application	442W LED - Non-Int. Ballast	Electronic	N/A	N/A	442	15
LED443-FIXT	LED443W	Non-Integrated Ballast LED, 443W, any bulb shape, any application	443W LED - Non-Int. Ballast	Electronic	N/A	N/A	443	15
LED444-FIXT	LED444W	Non-Integrated Ballast LED, 444W, any bulb shape, any application	444W LED - Non-Int. Ballast	Electronic	N/A	N/A	444	15
LED445-FIXT	LED445W	Non-Integrated Ballast LED, 445W, any bulb shape, any application	445W LED - Non-Int. Ballast	Electronic	N/A	N/A	445	15
LED446-FIXT	LED446W	Non-Integrated Ballast LED, 446W, any bulb shape, any application	446W LED - Non-Int. Ballast	Electronic	N/A	N/A	446	15
LED447-FIXT	LED447W	Non-Integrated Ballast LED, 447W, any bulb shape, any application	447W LED - Non-Int. Ballast	Electronic	N/A	N/A	447	15
LED448-FIXT	LED448W	Non-Integrated Ballast LED, 448W, any bulb shape, any application	448W LED - Non-Int. Ballast	Electronic	N/A	N/A	448	15
LED449-FIXT	LED449W	Non-Integrated Ballast LED, 449W, any bulb shape, any application	449W LED - Non-Int. Ballast	Electronic	N/A	N/A	449	15
LED450-FIXT	LED450W	Non-Integrated Ballast LED, 450W, any bulb shape, any application	450W LED - Non-Int. Ballast	Electronic	N/A	N/A	450	15
LED451-FIXT	LED451W	Non-Integrated Ballast LED, 451W, any bulb shape, any application	451W LED - Non-Int. Ballast	Electronic	N/A	N/A	451	15
LED452-FIXT	LED452W	Non-Integrated Ballast LED, 452W, any bulb shape, any application	452W LED - Non-Int. Ballast	Electronic	N/A	N/A	452	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED453-FIXT	LED453W	Non-Integrated Ballast LED, 453W, any bulb shape, any application	453W LED - Non-Int. Ballast	Electronic	N/A	N/A	453	15
LED454-FIXT	LED454W	Non-Integrated Ballast LED, 454W, any bulb shape, any application	454W LED - Non-Int. Ballast	Electronic	N/A	N/A	454	15
LED455-FIXT	LED455W	Non-Integrated Ballast LED, 455W, any bulb shape, any application	455W LED - Non-Int. Ballast	Electronic	N/A	N/A	455	15
LED456-FIXT	LED456W	Non-Integrated Ballast LED, 456W, any bulb shape, any application	456W LED - Non-Int. Ballast	Electronic	N/A	N/A	456	15
LED457-FIXT	LED457W	Non-Integrated Ballast LED, 457W, any bulb shape, any application	457W LED - Non-Int. Ballast	Electronic	N/A	N/A	457	15
LED458-FIXT	LED458W	Non-Integrated Ballast LED, 458W, any bulb shape, any application	458W LED - Non-Int. Ballast	Electronic	N/A	N/A	458	15
LED459-FIXT	LED459W	Non-Integrated Ballast LED, 459W, any bulb shape, any application	459W LED - Non-Int. Ballast	Electronic	N/A	N/A	459	15
LED460-FIXT	LED460W	Non-Integrated Ballast LED, 460W, any bulb shape, any application	460W LED - Non-Int. Ballast	Electronic	N/A	N/A	460	15
LED461-FIXT	LED461W	Non-Integrated Ballast LED, 461W, any bulb shape, any application	461W LED - Non-Int. Ballast	Electronic	N/A	N/A	461	15
LED462-FIXT	LED462W	Non-Integrated Ballast LED, 462W, any bulb shape, any application	462W LED - Non-Int. Ballast	Electronic	N/A	N/A	462	15
LED463-FIXT	LED463W	Non-Integrated Ballast LED, 463W, any bulb shape, any application	463W LED - Non-Int. Ballast	Electronic	N/A	N/A	463	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED464-FIXT	LED464W	Non-Integrated Ballast LED, 464W, any bulb shape, any application	464W LED - Non-Int. Ballast	Electronic	N/A	N/A	464	15
LED465-FIXT	LED465W	Non-Integrated Ballast LED, 465W, any bulb shape, any application	465W LED - Non-Int. Ballast	Electronic	N/A	N/A	465	15
LED466-FIXT	LED466W	Non-Integrated Ballast LED, 466W, any bulb shape, any application	466W LED - Non-Int. Ballast	Electronic	N/A	N/A	466	15
LED467-FIXT	LED467W	Non-Integrated Ballast LED, 467W, any bulb shape, any application	467W LED - Non-Int. Ballast	Electronic	N/A	N/A	467	15
LED468-FIXT	LED468W	Non-Integrated Ballast LED, 468W, any bulb shape, any application	468W LED - Non-Int. Ballast	Electronic	N/A	N/A	468	15
LED469-FIXT	LED469W	Non-Integrated Ballast LED, 469W, any bulb shape, any application	469W LED - Non-Int. Ballast	Electronic	N/A	N/A	469	15
LED470-FIXT	LED470W	Non-Integrated Ballast LED, 470W, any bulb shape, any application	470W LED - Non-Int. Ballast	Electronic	N/A	N/A	470	15
LED471-FIXT	LED471W	Non-Integrated Ballast LED, 471W, any bulb shape, any application	471W LED - Non-Int. Ballast	Electronic	N/A	N/A	471	15
LED472-FIXT	LED472W	Non-Integrated Ballast LED, 472W, any bulb shape, any application	472W LED - Non-Int. Ballast	Electronic	N/A	N/A	472	15
LED473-FIXT	LED473W	Non-Integrated Ballast LED, 473W, any bulb shape, any application	473W LED - Non-Int. Ballast	Electronic	N/A	N/A	473	15
LED474-FIXT	LED474W	Non-Integrated Ballast LED, 474W, any bulb shape, any application	474W LED - Non-Int. Ballast	Electronic	N/A	N/A	474	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED475-FIXT	LED475W	Non-Integrated Ballast LED, 475W, any bulb shape, any application	475W LED - Non-Int. Ballast	Electronic	N/A	N/A	475	15
LED476-FIXT	LED476W	Non-Integrated Ballast LED, 476W, any bulb shape, any application	476W LED - Non-Int. Ballast	Electronic	N/A	N/A	476	15
LED477-FIXT	LED477W	Non-Integrated Ballast LED, 477W, any bulb shape, any application	477W LED - Non-Int. Ballast	Electronic	N/A	N/A	477	15
LED478-FIXT	LED478W	Non-Integrated Ballast LED, 478W, any bulb shape, any application	478W LED - Non-Int. Ballast	Electronic	N/A	N/A	478	15
LED479-FIXT	LED479W	Non-Integrated Ballast LED, 479W, any bulb shape, any application	479W LED - Non-Int. Ballast	Electronic	N/A	N/A	479	15
LED480-FIXT	LED480W	Non-Integrated Ballast LED, 480W, any bulb shape, any application	480W LED - Non-Int. Ballast	Electronic	N/A	N/A	480	15
LED481-FIXT	LED481W	Non-Integrated Ballast LED, 481W, any bulb shape, any application	481W LED - Non-Int. Ballast	Electronic	N/A	N/A	481	15
LED482-FIXT	LED482W	Non-Integrated Ballast LED, 482W, any bulb shape, any application	482W LED - Non-Int. Ballast	Electronic	N/A	N/A	482	15
LED483-FIXT	LED483W	Non-Integrated Ballast LED, 483W, any bulb shape, any application	483W LED - Non-Int. Ballast	Electronic	N/A	N/A	483	15
LED484-FIXT	LED484W	Non-Integrated Ballast LED, 484W, any bulb shape, any application	484W LED - Non-Int. Ballast	Electronic	N/A	N/A	484	15
LED485-FIXT	LED485W	Non-Integrated Ballast LED, 485W, any bulb shape, any application	485W LED - Non-Int. Ballast	Electronic	N/A	N/A	485	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED486-FIXT	LED486W	Non-Integrated Ballast LED, 486W, any bulb shape, any application	486W LED - Non-Int. Ballast	Electronic	N/A	N/A	486	15
LED487-FIXT	LED487W	Non-Integrated Ballast LED, 487W, any bulb shape, any application	487W LED - Non-Int. Ballast	Electronic	N/A	N/A	487	15
LED488-FIXT	LED488W	Non-Integrated Ballast LED, 488W, any bulb shape, any application	488W LED - Non-Int. Ballast	Electronic	N/A	N/A	488	15
LED489-FIXT	LED489W	Non-Integrated Ballast LED, 489W, any bulb shape, any application	489W LED - Non-Int. Ballast	Electronic	N/A	N/A	489	15
LED490-FIXT	LED490W	Non-Integrated Ballast LED, 490W, any bulb shape, any application	490W LED - Non-Int. Ballast	Electronic	N/A	N/A	490	15
LED491-FIXT	LED491W	Non-Integrated Ballast LED, 491W, any bulb shape, any application	491W LED - Non-Int. Ballast	Electronic	N/A	N/A	491	15
LED492-FIXT	LED492W	Non-Integrated Ballast LED, 492W, any bulb shape, any application	492W LED - Non-Int. Ballast	Electronic	N/A	N/A	492	15
LED493-FIXT	LED493W	Non-Integrated Ballast LED, 493W, any bulb shape, any application	493W LED - Non-Int. Ballast	Electronic	N/A	N/A	493	15
LED494-FIXT	LED494W	Non-Integrated Ballast LED, 494W, any bulb shape, any application	494W LED - Non-Int. Ballast	Electronic	N/A	N/A	494	15
LED495-FIXT	LED495W	Non-Integrated Ballast LED, 495W, any bulb shape, any application	495W LED - Non-Int. Ballast	Electronic	N/A	N/A	495	15
LED496-FIXT	LED496W	Non-Integrated Ballast LED, 496W, any bulb shape, any application	496W LED - Non-Int. Ballast	Electronic	N/A	N/A	496	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED497-FIXT	LED497W	Non-Integrated Ballast LED, 497W, any bulb shape, any application	497W LED - Non-Int. Ballast	Electronic	N/A	N/A	497	15
LED498-FIXT	LED498W	Non-Integrated Ballast LED, 498W, any bulb shape, any application	498W LED - Non-Int. Ballast	Electronic	N/A	N/A	498	15
LED499-FIXT	LED499W	Non-Integrated Ballast LED, 499W, any bulb shape, any application	499W LED - Non-Int. Ballast	Electronic	N/A	N/A	499	15
LED500-FIXT	LED500W	Non-Integrated Ballast LED, 500W, any bulb shape, any application	500W LED - Non-Int. Ballast	Electronic	N/A	N/A	500	15
LED505-FIXT	LED505W	Non-Integrated Ballast LED, 505W, any bulb shape, any application	505W LED - Non-Int. Ballast	Electronic	N/A	N/A	505	15
LED510-FIXT	LED510W	Non-Integrated Ballast LED, 510W, any bulb shape, any application	510W LED - Non-Int. Ballast	Electronic	N/A	N/A	510	15
LED515-FIXT	LED515W	Non-Integrated Ballast LED, 515W, any bulb shape, any application	515W LED - Non-Int. Ballast	Electronic	N/A	N/A	515	15
LED520-FIXT	LED520W	Non-Integrated Ballast LED, 520W, any bulb shape, any application	520W LED - Non-Int. Ballast	Electronic	N/A	N/A	520	15
LED525-FIXT	LED525W	Non-Integrated Ballast LED, 525W, any bulb shape, any application	525W LED - Non-Int. Ballast	Electronic	N/A	N/A	525	15
LED530-FIXT	LED530W	Non-Integrated Ballast LED, 530W, any bulb shape, any application	530W LED - Non-Int. Ballast	Electronic	N/A	N/A	530	15
LED535-FIXT	LED535W	Non-Integrated Ballast LED, 535W, any bulb shape, any application	535W LED - Non-Int. Ballast	Electronic	N/A	N/A	535	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
LED540-FIXT	LED540W	Non-Integrated Ballast LED, 540W, any bulb shape, any application	540W LED - Non-Int. Ballast	Electronic	N/A	N/A	540	15
LED545-FIXT	LED545W	Non-Integrated Ballast LED, 545W, any bulb shape, any application	545W LED - Non-Int. Ballast	Electronic	N/A	N/A	545	15
LED550-FIXT	LED550W	Non-Integrated Ballast LED, 550W, any bulb shape, any application	550W LED - Non-Int. Ballast	Electronic	N/A	N/A	550	15
CF		Compact Fluorescent Fixtures						
CF2/1-SCRW	CF2W	Compact Fluorescent, (1) 2W screw-in lamp/base w/ permanent disk installed, any bulb shape	2W CFL	Mag. or Elec.	1	2	2	2.5
CF3/1-SCRW	CF3W	Compact Fluorescent, (1) 3W screw-in lamp/base w/ permanent disk installed, any bulb shape	3W CFL	Mag. or Elec.	1	3	3	2.5
CF4/1-SCRW	CF4W	Compact Fluorescent, (1) 4W screw-in lamp/base w/ permanent disk installed, any bulb shape	4W CFL	Mag. or Elec.	1	4	4	2.5
CF5/1-SCRW	CF5W	Compact Fluorescent, (1) 5W screw-in lamp/base w/ permanent disk installed, any bulb shape	5W CFL	Mag. or Elec.	1	5	5	2.5
CF6/1-SCRW	CF6W	Compact Fluorescent, (1) 6W screw-in lamp/base w/ permanent disk installed, any bulb shape	6W CFL	Mag. or Elec.	1	6	6	2.5
CF7/1-SCRW	CF7W	Compact Fluorescent, (1) 7W screw-in lamp/base w/ permanent disk installed, any bulb shape	7W CFL	Mag. or Elec.	1	7	7	2.5
CF8/1-SCRW	CF8W	Compact Fluorescent, (1) 8W screw-in lamp/base w/ permanent disk installed, any bulb shape	8W CFL	Mag. or Elec.	1	8	8	2.5
CF9/1-	CF9W	Compact Fluorescent, (1) 9W screw-in lamp/base w/ permanent disk	9W CFL	Mag. or Elec.	1	9	9	2.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
SCRW		installed, any bulb shape						
CF10/1-SCRW	CF10W	Compact Fluorescent, (1) 10W screw-in lamp/base w/ permanent disk installed, any bulb shape	10W CFL	Mag. or Elec.	1	10	10	2.5
CF11/1-SCRW	CF11W	Compact Fluorescent, (1) 11W screw-in lamp/base w/ permanent disk installed, any bulb shape	11W CFL	Mag. or Elec.	1	11	11	2.5
CF12/1-SCRW	CF12W	Compact Fluorescent, (1) 12W screw-in lamp/base w/ permanent disk installed, any bulb shape	12W CFL	Mag. or Elec.	1	12	12	2.5
CF13/1-SCRW	CF13W	Compact Fluorescent, (1) 13W screw-in lamp/base w/ permanent disk installed, any bulb shape	13W CFL	Mag. or Elec.	1	13	13	2.5
CF14/1-SCRW	CF14W	Compact Fluorescent, (1) 14W screw-in lamp/base w/ permanent disk installed, any bulb shape	14W CFL	Mag. or Elec.	1	14	14	2.5
CF15/1-SCRW	CF15W	Compact Fluorescent, (1) 15W screw-in lamp/base w/ permanent disk installed, any bulb shape	15W CFL	Mag. or Elec.	1	15	15	2.5
CF16/1-SCRW	CF16W	Compact Fluorescent, (1) 16W screw-in lamp/base w/ permanent disk installed, any bulb shape	16W CFL	Mag. or Elec.	1	16	16	2.5
CF17/1-SCRW	CF17W	Compact Fluorescent, (1) 17W screw-in lamp/base w/ permanent disk installed, any bulb shape	17W CFL	Mag. or Elec.	1	17	17	2.5
CF18/1-SCRW	CF18W	Compact Fluorescent, (1) 18W screw-in lamp/base w/ permanent disk installed, any bulb shape	18W CFL	Mag. or Elec.	1	18	18	2.5
CF19/1-SCRW	CF19W	Compact Fluorescent, (1) 19W screw-in lamp/base w/ permanent disk installed, any bulb shape	19W CFL	Mag. or Elec.	1	19	19	2.5
CF20/1-SCRW	CF20W	Compact Fluorescent, (1) 20W screw-in lamp/base w/ permanent disk installed, any bulb shape	20W CFL	Mag. or Elec.	1	20	20	2.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
CF21/1-SCRW	CF21W	Compact Fluorescent, (1) 21W screw-in lamp/base w/ permanent disk installed, any bulb shape	21W CFL	Mag. or Elec.	1	21	21	2.5
CF22/1-SCRW	CF22W	Compact Fluorescent, (1) 22W screw-in lamp/base w/ permanent disk installed, any bulb shape	22W CFL	Mag. or Elec.	1	22	22	2.5
CF23/1-SCRW	CF23W	Compact Fluorescent, (1) 23W screw-in lamp/base w/ permanent disk installed, any bulb shape	23W CFL	Mag. or Elec.	1	23	23	2.5
CF24/1-SCRW	CF24W	Compact Fluorescent, (1) 24W screw-in lamp/base w/ permanent disk installed, any bulb shape	24W CFL	Mag. or Elec.	1	24	24	2.5
CF25/1-SCRW	CF25W	Compact Fluorescent, (1) 25W screw-in lamp/base w/ permanent disk installed, any bulb shape	25W CFL	Mag. or Elec.	1	25	25	2.5
CF26/1-SCRW	CF26W	Compact Fluorescent, (1) 26W screw-in lamp/base w/ permanent disk installed, any bulb shape	26W CFL	Mag. or Elec.	1	26	26	2.5
CF27/1-SCRW	CF27W	Compact Fluorescent, (1) 27W screw-in lamp/base w/ permanent disk installed, any bulb shape	27W CFL	Mag. or Elec.	1	27	27	2.5
CF28/1-SCRW	CF28W	Compact Fluorescent, (1) 28W screw-in lamp/base w/ permanent disk installed, any bulb shape	28W CFL	Mag. or Elec.	1	28	28	2.5
CF29/1-SCRW	CF29W	Compact Fluorescent, (1) 29W screw-in lamp/base w/ permanent disk installed, any bulb shape	29W CFL	Mag. or Elec.	1	29	29	2.5
CF30/1-SCRW	CF30W	Compact Fluorescent, (1) 30W screw-in lamp/base w/ permanent disk installed, any bulb shape	30W CFL	Mag. or Elec.	1	30	30	2.5
CF31/1-SCRW	CF31W	Compact Fluorescent, (1) 31W screw-in lamp/base w/ permanent disk installed, any bulb shape	31W CFL	Mag. or Elec.	1	31	31	2.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
CF32/1-SCRW	CF32W	Compact Fluorescent, (1) 32W screw-in lamp/base w/ permanent disk installed, any bulb shape	32W CFL	Mag. or Elec.	1	32	32	2.5
CF33/1-SCRW	CF33W	Compact Fluorescent, (1) 33W screw-in lamp/base w/ permanent disk installed, any bulb shape	33W CFL	Mag. or Elec.	1	33	33	2.5
CF34/1-SCRW	CF34W	Compact Fluorescent, (1) 34W screw-in lamp/base w/ permanent disk installed, any bulb shape	34W CFL	Mag. or Elec.	1	34	34	2.5
CF35/1-SCRW	CF35W	Compact Fluorescent, (1) 35W screw-in lamp/base w/ permanent disk installed, any bulb shape	35W CFL	Mag. or Elec.	1	35	35	2.5
CF36/1-SCRW	CF36W	Compact Fluorescent, (1) 36W screw-in lamp/base w/ permanent disk installed, any bulb shape	36W CFL	Mag. or Elec.	1	36	36	2.5
CF37/1-SCRW	CF37W	Compact Fluorescent, (1) 37W screw-in lamp/base w/ permanent disk installed, any bulb shape	37W CFL	Mag. or Elec.	1	37	37	2.5
CF38/1-SCRW	CF38W	Compact Fluorescent, (1) 38W screw-in lamp/base w/ permanent disk installed, any bulb shape	38W CFL	Mag. or Elec.	1	38	38	2.5
CF39/1-SCRW	CF39W	Compact Fluorescent, (1) 39W screw-in lamp/base w/ permanent disk installed, any bulb shape	39W CFL	Mag. or Elec.	1	39	39	2.5
CF40/1-SCRW	CF40W	Compact Fluorescent, (1) 40W screw-in lamp/base w/ permanent disk installed, any bulb shape	40W CFL	Mag. or Elec.	1	40	40	2.5
CF41/1-SCRW	CF41W	Compact Fluorescent, (1) 41W screw-in lamp/base w/ permanent disk installed, any bulb shape	41W CFL	Mag. or Elec.	1	41	41	2.5
CF42/1-SCRW	CF42W	Compact Fluorescent, (1) 42W screw-in lamp/base w/ permanent disk installed, any bulb shape	42W CFL	Mag. or Elec.	1	42	42	2.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
CF43/1-SCRW	CF43W	Compact Fluorescent, (1) 43W screw-in lamp/base w/ permanent disk installed, any bulb shape	43W CFL	Mag. or Elec.	1	43	43	2.5
CF44/1-SCRW	CF44W	Compact Fluorescent, (1) 44W screw-in lamp/base w/permanent disk installed, any bulb shape	44W CFL	Mag. or Elec.	1	44	44	2.5
CF45/1-SCRW	CF45W	Compact Fluorescent, (1) 45W screw-in lamp/base w/permanent disk installed, any bulb shape	45W CFL	Mag. or Elec.	1	45	45	2.5
CF46/1-SCRW	CF46W	Compact Fluorescent, (1) 46W screw-in lamp/base w/permanent disk installed, any bulb shape	46W CFL	Mag. or Elec.	1	46	46	2.5
CF47/1-SCRW	CF47W	Compact Fluorescent, (1) 47W screw-in lamp/base w/permanent disk installed, any bulb shape	47W CFL	Mag. or Elec.	1	47	47	2.5
CF48/1-SCRW	CF48W	Compact Fluorescent, (1) 48W screw-in lamp/base w/permanent disk installed, any bulb shape	48W CFL	Mag. or Elec.	1	48	48	2.5
CF49/1-SCRW	CF49W	Compact Fluorescent, (1) 49W screw-in lamp/base w/permanent disk installed, any bulb shape	49W CFL	Mag. or Elec.	1	49	49	2.5
CF50/1-SCRW	CF50W	Compact Fluorescent, (1) 50W screw-in lamp/base w/permanent disk installed, any bulb shape	50W CFL	Mag. or Elec.	1	50	50	2.5
CF51/1-SCRW	CF51W	Compact Fluorescent, (1) 51W screw-in lamp/base w/permanent disk installed, any bulb shape	51W CFL	Mag. or Elec.	1	51	51	2.5
CF52/1-SCRW	CF52W	Compact Fluorescent, (1) 52W screw-in lamp/base w/permanent disk installed, any bulb shape	52W CFL	Mag. or Elec.	1	52	52	2.5
CF53/1-SCRW	CF53W	Compact Fluorescent, (1) 53W screw-in lamp/base w/permanent disk installed, any bulb shape	53W CFL	Mag. or Elec.	1	53	53	2.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
CF54/1-SCRW	CF54W	Compact Fluorescent, (1) 54W screw-in lamp/base w/permanent disk installed, any bulb shape	54W CFL	Mag. or Elec.	1	54	54	2.5
CF55/1-SCRW	CF55W	Compact Fluorescent, (1) 55W screw-in lamp/base w/permanent disk installed, any bulb shape	55W CFL	Mag. or Elec.	1	55	55	2.5
CF56/1-SCRW	CF56W	Compact Fluorescent, (1) 56W screw-in lamp/base w/permanent disk installed, any bulb shape	56W CFL	Mag. or Elec.	1	56	56	2.5
CF57/1-SCRW	CF57W	Compact Fluorescent, (1) 57W screw-in lamp/base w/permanent disk installed, any bulb shape	57W CFL	Mag. or Elec.	1	57	57	2.5
CF58/1-SCRW	CF58W	Compact Fluorescent, (1) 58W screw-in lamp/base w/permanent disk installed, any bulb shape	58W CFL	Mag. or Elec.	1	58	58	2.5
CF59/1-SCRW	CF59W	Compact Fluorescent, (1) 59W screw-in lamp/base w/permanent disk installed, any bulb shape	59W CFL	Mag. or Elec.	1	59	59	2.5
CF60/1-SCRW	CF60W	Compact Fluorescent, (1) 60W screw-in lamp/base w/permanent disk installed, any bulb shape	60W CFL	Mag. or Elec.	1	60	60	2.5
CF61/1-SCRW	CF61W	Compact Fluorescent, (1) 61W screw-in lamp/base w/permanent disk installed, any bulb shape	61W CFL	Mag. or Elec.	1	61	61	2.5
CF62/1-SCRW	CF62W	Compact Fluorescent, (1) 62W screw-in lamp/base w/permanent disk installed, any bulb shape	62W CFL	Mag. or Elec.	1	62	62	2.5
CF63/1-SCRW	CF63W	Compact Fluorescent, (1) 63W screw-in lamp/base w/permanent disk installed, any bulb shape	63W CFL	Mag. or Elec.	1	63	63	2.5
CF64/1-SCRW	CF64W	Compact Fluorescent, (1) 64W screw-in lamp/base w/permanent disk installed, any bulb shape	64W CFL	Mag. or Elec.	1	64	64	2.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
CF65/1-SCRW	CF65W	Compact Fluorescent, (1) 65W screw-in lamp/base w/permanent disk installed, any bulb shape	65W CFL	Mag. or Elec.	1	65	65	2.5
CF66/1-SCRW	CF66W	Compact Fluorescent, (1) 66W screw-in lamp/base w/permanent disk installed, any bulb shape	66W CFL	Mag. or Elec.	1	66	66	2.5
CF67/1-SCRW	CF67W	Compact Fluorescent, (1) 67W screw-in lamp/base w/permanent disk installed, any bulb shape	67W CFL	Mag. or Elec.	1	67	67	2.5
CF68/1-SCRW	CF68W	Compact Fluorescent, (1) 68W screw-in lamp/base w/permanent disk installed, any bulb shape	68W CFL	Mag. or Elec.	1	68	68	2.5
CF69/1-SCRW	CF69W	Compact Fluorescent, (1) 69W screw-in lamp/base w/permanent disk installed, any bulb shape	69W CFL	Mag. or Elec.	1	69	69	2.5
CF70/1-SCRW	CF70W	Compact Fluorescent, (1) 70W screw-in lamp/base w/permanent disk installed, any bulb shape	70W CFL	Mag. or Elec.	1	70	70	2.5
CF71/1-SCRW	CF71W	Compact Fluorescent, (1) 71W screw-in lamp/base w/permanent disk installed, any bulb shape	71W CFL	Mag. or Elec.	1	71	71	2.5
CF72/1-SCRW	CF72W	Compact Fluorescent, (1) 72W screw-in lamp/base w/permanent disk installed, any bulb shape	72W CFL	Mag. or Elec.	1	72	72	2.5
CF73/1-SCRW	CF73W	Compact Fluorescent, (1) 73W screw-in lamp/base w/permanent disk installed, any bulb shape	73W CFL	Mag. or Elec.	1	73	73	2.5
CF74/1-SCRW	CF74W	Compact Fluorescent, (1) 74W screw-in lamp/base w/permanent disk installed, any bulb shape	74W CFL	Mag. or Elec.	1	74	74	2.5
CF75/1-SCRW	CF75W	Compact Fluorescent, (1) 75W screw-in lamp/base w/permanent disk installed, any bulb shape	75W CFL	Mag. or Elec.	1	75	75	2.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
CF80/1-SCRW	CF80W	Compact Fluorescent, (1) 80W screw-in lamp/base w/permanent disk installed, any bulb shape	80W CFL	Mag. or Elec.	1	80	80	2.5
CF85/1-SCRW	CF85W	Compact Fluorescent, (1) 85W screw-in lamp/base w/permanent disk installed, any bulb shape	85W CFL	Mag. or Elec.	1	85	85	2.5
CF100/1-SCRW	CF100W	Compact Fluorescent, (1) 100W screw-in lamp/base w/ permanent disk installed, any bulb shape	100W CFL	Mag. or Elec.	1	100	100	2.5
CF125/1-SCRW	CF125W	Compact Fluorescent, (1) 125W screw-in lamp/base w/ permanent disk installed, any bulb shape	125W CFL	Mag. or Elec.	1	125	125	2.5
CF150/1-SCRW	CF150W	Compact Fluorescent, (1) 150W screw-in lamp/base w/ permanent disk installed, any bulb shape	150W CFL	Mag. or Elec.	1	150	150	2.5
CF200/1-SCRW	CF200W	Compact Fluorescent, (1) 200W screw-in lamp/base w/ permanent disk installed, any bulb shape	200W CFL	Mag. or Elec.	1	200	200	2.5
CFC2/1-SCRW	CFC2W	Compact Fluorescent, Cold Cathode, (1) 2W screw-in lamp/base w/ permanent locking device, any bulb shape	2W Cold Cathode	Electronic	1	2	2	4.5
CFC2/2-SCRW	CFC2W	Compact Fluorescent, Cold Cathode, (2) 2W screw-in lamp/base w/ permanent locking device, any bulb shape	4W Cold Cathode	Electronic	2	2	4	4.5
CFC3/1-SCRW	CFC3W	Compact Fluorescent, Cold Cathode, (1) 3W screw-in lamp/base w/ permanent locking device, any bulb shape	3W Cold Cathode	Electronic	1	3	3	4.5
CFC3/2-SCRW	CFC3W	Compact Fluorescent, Cold Cathode, (2) 3W screw-in lamp/base w/ permanent locking device, any bulb shape	6W Cold Cathode	Electronic	2	3	6	4.5
CFC4/1-SCRW	CFC4W	Compact Fluorescent, Cold Cathode, (1) 4W screw-in lamp/base w/ permanent locking device, any bulb shape	4W Cold Cathode	Electronic	1	4	4	4.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
CFC4/2-SCRW	CFC4W	Compact Fluorescent, Cold Cathode, (2) 4W screw-in lamp/base w/ permanent locking device, any bulb shape	8W Cold Cathode	Electronic	2	4	8	4.5
CFC5/1-SCRW	CFC5W	Compact Fluorescent, Cold Cathode, (1) 5W screw-in lamp/base w/ permanent locking device, any bulb shape	5W Cold Cathode	Electronic	1	5	5	4.5
CFC5/2-SCRW	CFC5W	Compact Fluorescent, Cold Cathode, (2) 5W screw-in lamp/base w/ permanent locking device, any bulb shape	10W Cold Cathode	Electronic	2	5	10	4.5
CFC8/1-SCRW	CFC8W	Compact Fluorescent, Cold Cathode, (1) 8W screw-in lamp/base w/ permanent locking device, any bulb shape	8W Cold Cathode	Electronic	1	8	8	4.5
CFC8/2-SCRW	CFC8W	Compact Fluorescent, Cold Cathode, (2) 8W screw-in lamp/base w/ permanent locking device, any bulb shape	16W Cold Cathode	Electronic	2	8	16	4.5
CFC13/1-SCRW	CFC13W	Compact Fluorescent, Cold Cathode, (1) 13W screw-in lamp/base w/ permanent locking device, any bulb shape	13W Cold Cathode	Electronic	1	13	13	4.5
CFC18/1-SCRW	CFC18W	Compact Fluorescent, Cold Cathode, (1) 18W screw-in lamp/base w/ permanent locking device, any bulb shape	18W Cold Cathode	Electronic	1	18	18	4.5
CFD10/1	CFD10W	Compact Fluorescent, 2D, (1) 10W lamp	1-Lamp 10W CFL 2D	Mag-STD	1	10	16	16
CFD10/1-L	CFD10W	Compact Fluorescent, 2D, (1) 10W lamp	1-Lamp 10W CFL 2D	Electronic	1	10	14	16
CFD16/1	CFD16W	Compact Fluorescent, 2D, (1) 16W lamp	1-Lamp 16W CFL 2D	Mag-STD	1	16	26	16
CFD16/1-L	CFD16W	Compact Fluorescent, 2D, (1) 16W lamp	1-Lamp 16W CFL 2D	Electronic	1	16	18	16
CFD21/1	CFD21W	Compact Fluorescent, 2D, (1) 21W lamp	1-Lamp 21W CFL 2D	Mag-STD	1	21	26	16
CFD21/1-L	CFD21W	Compact Fluorescent, 2D, (1) 21W lamp	1-Lamp 21W CFL 2D	Electronic	1	21	22	16

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
CFD28/1	CFD28W	Compact Fluorescent, 2D, (1) 28W lamp	1-Lamp 28W CFL 2D	Mag-STD	1	28	35	16
CFD28/1-L	CFD28W	Compact Fluorescent, 2D, (1) 28W lamp	1-Lamp 28W CFL 2D	Electronic	1	28	29	16
CFD38/1	CFD38W	Compact Fluorescent, 2D, (1) 38W lamp	1-Lamp 38W CFL 2D	Mag-STD	1	38	46	16
CFD38/1-L	CFD38W	Compact Fluorescent, 2D, (1) 38W lamp	1-Lamp 38W CFL 2D	Electronic	1	38	32	16
CFG13/1-L	CFG13W	Compact Fluorescent, Multi, GU24 with Integrated Ballast, (1) 13W lamp	1-Lamp 13W CFL Multi	Electronic	1	13	13	16
CFG18/1-L	CFG18W	Compact Fluorescent, Multi, GU24 with Integrated Ballast, (1) 18W lamp	1-Lamp 18W CFL Multi	Electronic	1	18	18	16
CFG23/1-L	CFG23W	Compact Fluorescent, Multi, GU24 with Integrated Ballast, (1) 23W lamp	1-Lamp 23W CFL Multi	Electronic	1	23	23	16
CFG26/1-L	CFG26W	Compact Fluorescent, Multi, GU24 with Integrated Ballast, (1) 26W lamp	1-Lamp 26W CFL Multi	Electronic	1	26	26	16
CFG32/1-L	CFG32W	Compact Fluorescent, Multi, GU24 with Integrated Ballast, (1) 32W lamp	1-Lamp 32W CFL Multi	Electronic	1	32	32	16
CFG42/1-L	CFG42W	Compact Fluorescent, Multi, GU24 with Integrated Ballast, (1) 42W lamp	1-Lamp 42W CFL Multi	Electronic	1	42	42	16
CFM13/1-L	CFM13W	Compact Fluorescent, Multi, 4-pin, (1) 13W lamp	1-Lamp 13W CFL Multi 4-Pin	Electronic	1	13	16	16
CFM13/2-L	CFM13W	Compact Fluorescent, Multi, 4-pin, (2) 13W lamps	2-Lamp 13W CFL Multi 4-Pin	Electronic	2	13	30	16
CFM15/1-	CFM15W	Compact Fluorescent, Multi, 4-pin, (1) 15W lamp	1-Lamp 15W CFL Multi	Electronic	1	15	18	16

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
L			4-Pin					
CFM18/1-L	CFM18W	Compact Fluorescent, Multi, 4-pin, (1) 18W lamp	1-Lamp 18W CFL Multi 4-Pin	Electronic	1	18	20	16
CFM18/2-L	CFM18W	Compact Fluorescent, Multi, 4-pin, (2) 18W lamps	2-Lamp 18W CFL Multi 4-Pin	Electronic	2	18	40	16
CFM21/1-L	CFM21W	Compact Fluorescent, Multi, 4-pin, (1) 21W lamp	1-Lamp 21W CFL Multi 4-Pin	Electronic	1	21	23	16
CFM26/1-L	CFM26W	Compact Fluorescent, Multi, 4-pin, (1) 26W lamp	1-Lamp 26W CFL Multi 4-Pin	Electronic	1	26	29	16
CFM26/2-L	CFM26W	Compact Fluorescent, Multi, 4-pin, (2) 26W lamps	2-Lamp 26W CFL Multi 4-Pin	Electronic	2	26	51	16
CFM28/1-L	CFM28W	Compact Fluorescent, Multi, 4-pin, (1) 28W lamp	1-Lamp 28W CFL Multi 4-Pin	Electronic	1	28	31	16
CFM32/1-L	CFM32W	Compact Fluorescent, Multi, 4-pin, (1) 32W lamp	1-Lamp 32W CFL Multi 4-Pin	Electronic	1	32	35	16
CFM42/1-L	CFM42W	Compact Fluorescent, Multi, 4-pin, (1) 42W lamp	1-Lamp 42W CFL Multi 4-Pin	Electronic	1	42	46	16
CFM42/2-L	CFM42W	Compact Fluorescent, Multi, 4-pin, (2) 42W lamps	2-Lamp 42W CFL Multi 4-Pin	Electronic	2	42	93	16
CFM42/8-L	CFM42W	Compact Fluorescent, Multi, 4-pin, (8) 42W lamps, (4) 2-lamp ballasts	8-Lamp 42W CFL Multi 4-Pin	Electronic	8	42	372	16
CFM57/1-L	CFM57W	Compact Fluorescent, Multi, 4-pin, (1) 57W lamp	1-Lamp 57W CFL Multi 4-Pin	Electronic	1	57	59	16

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
CFM60/1-L	CFM60W	Compact Fluorescent, Multi, 4-pin, (1) 60W lamp	1-Lamp 60W CFL Multi 4-Pin	Electronic	1	60	70	16
CFM70/1-L	CFM70W	Compact Fluorescent, Multi, 4-pin, (1) 70W lamp	1-Lamp 70W CFL Multi 4-Pin	Electronic	1	70	73	16
CFM85/1-L	CFM85W	Compact Fluorescent, Multi, 4-pin, (1) 85W lamp	1-Lamp 85W CFL Multi 4-Pin	Electronic	1	85	96	16
CFM120/1-L	CFM120W	Compact Fluorescent, Multi, 4-pin, (1) 120W lamp	1-Lamp 120W CFL Multi 4-Pin	Electronic	1	120	135	16
CFQ9/1	CFQ9W	Compact Fluorescent, Quad, (1) 9W lamp	1-Lamp 9W CFL Quad	Mag-STD	1	9	14	16
CFQ9/2	CFQ9W	Compact Fluorescent, Quad, (2) 9W lamps	2-Lamp 9W CFL Quad	Mag-STD	2	9	23	16
CFQ10/1	CFQ10W	Compact Fluorescent, quad, (1) 10W lamp	1-Lamp 10W CFL Quad	Mag-STD	1	10	15	16
CFQ13/1	CFQ13W	Compact Fluorescent, quad, (1) 13W lamp	1-Lamp 13W CFL Quad	Mag-STD	1	13	17	16
CFQ13/1-L	CFQ13W	Compact Fluorescent, quad, (1) 13W lamp, BF=1.05	1-Lamp 13W CFL Quad	Electronic	1	13	15	16
CFQ13/2	CFQ13W	Compact Fluorescent, quad, (2) 13W lamps	2-Lamp 13W CFL Quad	Mag-STD	2	13	31	16
CFQ13/2-L	CFQ13W	Compact Fluorescent, quad, (2) 13W lamps, BF=1.0	2-Lamp 13W CFL Quad	Electronic	2	13	28	16
CFQ13/3	CFQ13W	Compact Fluorescent, quad, (3) 13W lamps	3-Lamp 13W CFL Quad	Mag-STD	3	13	48	16
CFQ15/1	CFQ15W	Compact Fluorescent, quad, (1) 15W lamp	1-Lamp 15W CFL Quad	Mag-STD	1	15	20	16
CFQ17/1	CFQ17W	Compact Fluorescent, quad, (1) 17W lamp	1-Lamp 17W CFL Quad	Mag-STD	1	17	24	16
CFQ17/2	CFQ17W	Compact Fluorescent, quad, (2) 17W lamps	2-Lamp 17W CFL Quad	Mag-STD	2	17	48	16

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
CFQ18/1	CFQ18W	Compact Fluorescent, quad, (1) 18W lamp	1-Lamp 18W CFL Quad	Mag-STD	1	18	26	16
CFQ18/1-L	CFQ18W	Compact Fluorescent, quad, (1) 18W lamp, BF=1.0	1-Lamp 18W CFL Quad	Electronic	1	18	20	16
CFQ18/2	CFQ18W	Compact Fluorescent, quad, (2) 18W lamps	2-Lamp 18W CFL Quad	Mag-STD	2	18	45	16
CFQ18/2-L	CFQ18W	Compact Fluorescent, quad, (2) 18W lamp, BF=1.0	2-Lamp 18W CFL Quad	Electronic	2	18	38	16
CFQ18/4	CFQ18W	Compact Fluorescent, quad, (4) 18W lamps	4-Lamp 18W CFL Quad	Mag-STD	2	18	90	16
CFQ20/1	CFQ20W	Compact Fluorescent, quad, (1) 20W lamp	1-Lamp 20W CFL Quad	Mag-STD	1	20	23	16
CFQ20/2	CFQ20W	Compact Fluorescent, quad, (2) 20W lamps	2-Lamp 20W CFL Quad	Mag-STD	2	20	46	16
CFQ22/1	CFQ22W	Compact Fluorescent, Quad, (1) 22W lamp	1-Lamp 22W CFL Quad	Mag-STD	1	22	24	16
CFQ22/2	CFQ22W	Compact Fluorescent, Quad, (2) 22W lamps	2-Lamp 22W CFL Quad	Mag-STD	2	22	48	16
CFQ22/3	CFQ22W	Compact Fluorescent, Quad, (3) 22W lamps	3-Lamp 22W CFL Quad	Mag-STD	3	22	72	16
CFQ23/1	CFQ23W	Compact Fluorescent, Quad, (1) 23W lamp	1-Lamp 23W CFL Quad	Mag-STD	1	23	27	16
CFQ25/1	CFQ25W	Compact Fluorescent, Quad, (1) 25W lamp	1-Lamp 25W CFL Quad	Mag-STD	1	25	33	16
CFQ25/2	CFQ25W	Compact Fluorescent, Quad, (2) 25W lamps	2-Lamp 25W CFL Quad	Mag-STD	2	25	66	16
CFQ26/1	CFQ26W	Compact Fluorescent, quad, (1) 26W lamp	1-Lamp 26W CFL Quad	Mag-STD	1	26	33	16
CFQ26/1-L	CFQ26W	Compact Fluorescent, quad, (1) 26W lamp, BF=0.95	1-Lamp 26W CFL Quad	Electronic	1	26	27	16
CFQ26/2	CFQ26W	Compact Fluorescent, quad, (2) 26W lamps	2-Lamp 26W CFL Quad	Mag-STD	2	26	66	16
CFQ26/2-L	CFQ26W	Compact Fluorescent, quad, (2) 26W lamps, BF=0.95	2-Lamp 26W CFL Quad	Electronic	2	26	50	16

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
CFQ26/3	CFQ26W	Compact Fluorescent, quad, (3) 26W lamps	3-Lamp 26W CFL Quad	Mag-STD	3	26	99	16
CFQ26/6-L	CFQ26W	Compact Fluorescent, quad, (6) 26W lamps, BF=0.95	6-Lamp 26W CFL Quad	Electronic	6	26	150	16
CFQ28/1	CFQ28W	Compact Fluorescent, quad, (1) 28W lamp	1-Lamp 28W CFL Quad	Mag-STD	1	28	33	16
CFQ28/1-L	CFQ28W	Compact Fluorescent, quad, (1) 28W lamp	1-Lamp 28W CFL Quad	Electronic	1	28	31	16
CFQ28/2-L	CFQ28W	Compact Fluorescent, quad, (2) 28W lamps	2-Lamp 28W CFL Quad	Electronic	2	28	60	16
CFT5/1	CFT5W	Compact Fluorescent, twin, (1) 5W lamp	1-Lamp 5W CFL Twin	Mag-STD	1	5	9	16
CFT5/2	CFT5W	Compact Fluorescent, long twin, (2) 5W lamps	2-Lamp 5W CFL Twin	Mag-STD	2	5	18	16
CFT7/1	CFT7W	Compact Fluorescent, twin, (1) 7W lamp	1-Lamp 7W CFL Twin	Mag-STD	1	7	10	16
CFT7/2	CFT7W	Compact Fluorescent, twin, (2) 7W lamps	2-Lamp 7W CFL Twin	Mag-STD	2	7	21	16
CFT9/1	CFT9W	Compact Fluorescent, twin, (1) 9W lamp	1-Lamp 9W CFL Twin	Mag-STD	1	9	12	16
CFT9/2	CFT9W	Compact Fluorescent, twin, (2) 9W lamps	2-Lamp 9W CFL Twin	Mag-STD	2	9	23	16
CFT9/3	CFT9W	Compact Fluorescent, twin, (3) 9 W lamps	3-Lamp 9W CFL Twin	Mag-STD	3	9	34	16
CFT13/1	CFT13W	Compact Fluorescent, twin, (1) 13W lamp	1-Lamp 13W CFL Twin	Mag-STD	1	13	17	16
CFT13/1-L	CFT13W	Compact Fluorescent, twin, (1) 13W lamp	1-Lamp 13W CFL Twin	Electronic	1	13	15	16
CFT13/2	CFT13W	Compact Fluorescent, twin, (2) 13W lamps	2-Lamp 13W CFL Twin	Mag-STD	2	13	31	16
CFT13/2-L	CFT13W	Compact Fluorescent, twin, (2) 13W lamps	2-Lamp 13W CFL Twin	Electronic	2	13	28	16
CFT13/3	CFT13W	Compact Fluorescent, twin, (3) 13 W lamps	3-Lamp 13W CFL Twin	Mag-STD	3	13	48	16

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
CFT18/1	CFT18W	Compact Fluorescent, Long twin., (1) 18W lamp	1-Lamp 18W CFL Twin	Mag-STD	1	18	24	16
CFT18/1-L	CFT18W	Compact Fluorescent, twin, (1) 18W lamp	1-Lamp 18W CFL Twin	Electronic	1	18	20	16
CFT18/2	CFT18W	Compact Fluorescent, twin, (2) 18 W lamps	2-Lamp 18W CFL Twin	Mag-STD	2	18	38	16
CFT22/1	CFT22W	Compact Fluorescent, twin, (1) 22W lamp	1-Lamp 22W CFL Twin	Mag-STD	1	22	27	16
CFT22/2	CFT22W	Compact Fluorescent, twin, (2) 22W lamps	2-Lamp 22W CFL Twin	Mag-STD	2	22	54	16
CFT22/4	CFT22W	Compact Fluorescent, twin, (4) 22W lamps	4-Lamp 22W CFL Twin	Mag-STD	4	22	108	16
CFT24/1	CFT24W	Compact Fluorescent, long twin, (1) 24W lamp	1-Lamp 24W CFL Twin	Mag-STD	1	24	32	16
CFT26/1	CFT26W	Compact Fluorescent, twin, (1) 26W lamp	1-Lamp 26W CFL Twin	Mag-STD	1	26	32	16
CFT26/1-L	CFT26W	Compact Fluorescent, twin, (1) 26W lamp	1-Lamp 26W CFL Twin	Electronic	1	26	27	16
CFT26/2-L	CFT26W	Compact Fluorescent, twin, (2) 26W lamps	2-Lamp 26W CFL Twin	Electronic	2	26	51	16
CFT28/1	CFT28W	Compact Fluorescent, twin, (1) 28W lamp	1-Lamp 28W CFL Twin	Mag-STD	1	28	33	16
CFT28/2	CFT28W	Compact Fluorescent, twin, (2) 28W lamps	2-Lamp 28W CFL Twin	Mag-STD	2	28	66	16
CFT32/1-L	CFT32W	Compact Fluorescent, twin, (1) 32W lamp	1-Lamp 32W CFL Twin	Electronic	1	32	34	16
CFT32/2-L	CFT32W	Compact Fluorescent, twin, (2) 32W lamps	2-Lamp 32W CFL Twin	Electronic	2	32	62	16
CFT32/6-L	CFT32W	Compact Fluorescent, twin, (6) 32W lamps	6-Lamp 32W CFL Twin	Electronic	6	32	186	16
CFT36/1	CFT36W	Compact Fluorescent, long twin, (1) 36W lamp	1-Lamp 36W CFL Long Twin	Mag-STD	1	36	51	16

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
CFT40/1	CFT40W	Compact Fluorescent, long twin, (1) 40W lamp	1-Lamp 40W CFL Long Twin	Mag-STD	1	40	46	16
CFT40/1-L	CFT40W	Compact Fluorescent, long twin, (1) 40W lamp	1-Lamp 40W CFL Long Twin	Electronic	1	40	43	16
CFT40/2	CFT40W	Compact Fluorescent, long twin, (2) 40W lamps	2-Lamp 40W CFL Long Twin	Mag-STD	2	40	85	16
CFT40/2-L	CFT40W	Compact Fluorescent, long twin, (2) 40W lamps	2-Lamp 40W CFL Long Twin	Electronic	2	40	72	16
CFT40/3	CFT40W	Compact Fluorescent, long twin, (3) 40 W lamps	3-Lamp 40W CFL Long Twin	Mag-STD	3	40	133	16
CFT40/3-L	CFT40W	Compact Fluorescent, long twin, (3) 40W lamps	3-Lamp 40W CFL Long Twin	Electronic	3	40	105	16
CFT40/5-L	CFT40W	Compact Fluorescent, long twin, (5) 40W lamps	5-Lamp 40W CFL Long Twin	Electronic	5	40	177	16
CFT50/1-L	CFT50W	Compact Fluorescent, long twin, (1) 50W lamp	1-Lamp 50W CFL Long Twin	Electronic	1	50	54	16
CFT50/2-L	CFT50W	Compact Fluorescent, long twin, (2) 50W lamps	1-Lamp 50W CFL Long Twin	Electronic	1	50	108	16
CFT55/1-L	CFT55W	Compact Fluorescent, long twin, (1) 55W lamp	1-Lamp 55W CFL Long Twin	Electronic	1	55	58	16
CFT55/2-L	CFT55W	Compact Fluorescent, long twin, (2) 55W lamps	2-Lamp 55W CFL Long Twin	Electronic	2	55	108	16

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
CFT55/3-L	CFT55W	Compact Fluorescent, long twin, (3) 55W lamps	3-Lamp 55W CFL Long Twin	Electronic	3	55	168	16
CFT55/4-L	CFT55W	Compact Fluorescent, long twin, (4) 55W lamps	4-Lamp 55W CFL Long Twin	Electronic	4	55	220	16
CFT80/1-L	CFT80W	Compact Fluorescent, long twin, (1) 80W lamp	1-Lamp 80W CFL Long Twin	Electronic	1	80	90	16
ECF		EXIT Sign Fixtures						
ECF5/1	CFT5W	EXIT Compact Fluorescent, (1) 5W lamp	1-Lamp 5W CFL Exit	Mag-STD	1	5	9	16
ECF5/2	CFT5W	EXIT Compact Fluorescent, (2) 5W lamps	2-Lamp 5W CFL Exit	Mag-STD	2	5	20	16
ECF6/1	CFT6W	EXIT Compact Fluorescent, (1) 6W lamp	1-Lamp 6W CFL Exit	Mag-STD	1	6	13	16
ECF6/2	CFT6W	EXIT Compact Fluorescent, (2) 6W lamps, (2) ballasts	2-Lamp 6W CFL Exit	Mag-STD	2	6	26	16
ECF7/1	CFT7W	EXIT Compact Fluorescent, (1) 7W lamp	1-Lamp 7W CFL Exit	Mag-STD	1	7	10	16
ECF7/2	CFT7W	EXIT Compact Fluorescent, (2) 7W lamps	2-Lamp 7W CFL Exit	Mag-STD	2	7	21	16
ECF9/1	CFT9W	EXIT Compact Fluorescent, (1) 9W lamp	1-Lamp 9W CFL Exit	Mag-STD	1	9	12	16
ECF9/2	CFT9W	EXIT Compact Fluorescent, (2) 9W lamps	2-Lamp 9W CFL Exit	Mag-STD	2	9	20	16
EF2/2	F2T1	EXIT Sub-miniature T-1 Fluorescent, (2) lamps	2-Lamp 2W T-1 Exit	Electronic	2	2	5	16
EF6/1	F6T5	EXIT Miniature Bi-pin Fluorescent, (1) 6W lamp, (1) ballast	1-Lamp 6W Bi-Pin Fluorescent Exit	Mag-STD	1	6	9	16
EF6/2	F6T5	EXIT Miniature Bi-pin Fluorescent, (2) 6W lamps, (2) ballasts	2-Lamp 6W Bi-Pin	Mag-STD	2	6	18	16

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
			Fluorescent Exit					
EF8/1	F8T5	EXIT T5 Fluorescent, (1) 8W lamp	1-Lamp 8W T-5 Exit	Mag-STD	1	8	12	16
EF8/2	F8T5	EXIT T5 Fluorescent, (2) 8W lamps	2-Lamp 8W T-5 Exit	Mag-STD	2	8	24	16
EI5/1	I5	EXIT Incandescent, (1) 5W lamp	1-Lamp 5W incandescent Exit		1	5	5	1.5
EI5/2	I5	EXIT Incandescent, (2) 5W lamps	2-Lamp 5W incandescent Exit		2	5	10	1.5
EI7.5/1	I7.5	EXIT Tungsten, (1) 7.5 W lamp	1-Lamp 7.5W Tungsten Exit		1	7.5	8	1.5
EI7.5/2	I7.5	EXIT Tungsten, (2) 7.5 W lamps	2-Lamp 7.5W Tungsten Exit		2	7.5	15	1.5
EI10/2	I10	EXIT Incandescent, (2) 10W lamps	2-Lamp 10W incandescent Exit		2	10	20	1.5
EI15/1	I15	EXIT Incandescent, (1) 15W lamp	1-Lamp 15W incandescent Exit		1	15	15	1.5
EI15/2	I15	EXIT Incandescent, (2) 15W lamps	2-Lamp 15W incandescent Exit		2	15	30	1.5
EI20/1	I20	EXIT Incandescent, (1) 20W lamp	1-Lamp 20W incandescent Exit		1	20	20	1.5
EI20/2	I20	EXIT Incandescent, (2) 20W lamps	2-Lamp 20W incandescent Exit		2	20	40	1.5
EI25/1	I25	EXIT Incandescent, (1) 25W lamp	1-Lamp 25W		1	25	25	1.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
			incandescent Exit					
EI25/2	I25	EXIT Incandescent, (2) 25W lamps	2-Lamp 25W incandescent Exit		2	25	50	1.5
EI34/1	I34	EXIT Incandescent, (1) 34W lamp	1-Lamp 34W incandescent Exit		1	34	34	1.5
EI34/2	I34	EXIT Incandescent, (2) 34W lamps	2-Lamp 34W incandescent Exit		2	34	68	1.5
EI40/1	I40	EXIT Incandescent, (1) 40W lamp	1-Lamp 40W incandescent Exit		1	40	40	1.5
EI40/2	I40	EXIT Incandescent, (2) 40W lamps	2-Lamp 40W incandescent Exit		2	40	80	1.5
EI50/2	I50	EXIT Incandescent, (2) 50W lamps	2-Lamp 50W incandescent Exit		2	50	100	1.5
EI6/1	6S6	EXIT Incandescent, (1) 6 W lamp	1-Lamp 6W incandescent Exit		1	6	6	1.5
EI6/2	6S6	EXIT Incandescent, (2) 6 W lamps	2-Lamp 6W incandescent Exit		2	6	12	1.5
ELED2/1	LED2W	EXIT Light Emitting Diode, (1) 2W lamp, Single Sided	1-Lamp 2W LED Exit		1	2	6	15
ELED2/2	LED2W	EXIT Light Emitting Diode, (2) 2W lamps, Dual Sided	2-Lamp 2W LED Exit		2	2	9	15
ELED3	LED3W	EXIT Light Emitting Diode, (1) 3W lamp, Single Sided	1-Lamp 3W LED Exit		1	3	3	15
EP	P0W	EXIT Photoluminescent, 0W	Photoluminescent Exit Sign		0	0	0	15

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
FT5		T5 Linear Fluorescent Systems						
F22PS	F13T5	Fluorescent, (2) 21", Preheat T5 lamps, (1) Magnetic ballasts with integral starter, (BF=0.80)	2' 2-Lamp T5	Mag-STD	2	13	26	15.5
F24PS	F13T5	Fluorescent, (4) 21", Preheat T5 lamps, (2) Magnetic ballasts with integral starter (BF=0.80)	2' 4-Lamp T5	Mag-STD	4	13	53	15.5
F21GPL-H	F14T5	Fluorescent (1) 22" (563mm) T-5 lamp; (1) Prog.Start or PRS Ballast, HLO (.95 < BF < 1.1)	2' 1-Lamp T5	PRS Elec.	1	14	18	15.5
F22GPL-H	F14T5	Fluorescent (2) 22" (563mm) T-5 lamps; (1) Prog.Start or PRS Ballast, HLO (.95 < BF < 1.1)	2' 2-Lamp T5	PRS Elec.	2	14	33	15.5
F23GPL-H	F14T5	Fluorescent (3) 22" (563mm)T-5 lamps; (1) Prog.Start or PRS Ballast, HLO (.95 < BF < 1.1)	2' 3-Lamp T5	PRS Elec.	3	14	50	15.5
F23GPL/2-H	F14T5	Fluorescent (3) 22" (563mm)T-5 lamps; (2) Prog.Start or PRS Ballasts, HLO (.95 < BF < 1.1)	2' 3-Lamp T5	PRS Elec.	3	14	51	15.5
F24GPL/2-H	F14T5	Fluorescent (4) 22" (563mm)T-5 lamps; (2) Prog.Start or PRS Ballasts, HLO (.95 < BF < 1.1)	2' 4-Lamp T5	PRS Elec.	4	14	66	15.5
F31GPL-H	F21T5	Fluorescent (1) 34" (863mm) T-5 lamp; (1) Prog.Start or PRS Ballast, HLO (.95 < BF < 1.1)	3' 1-Lamp T5	PRS Elec.	1	21	25	15.5
F32GPL-H	F21T5	Fluorescent (2) 34" (863mm) T-5 lamps; (1) Prog.Start or PRS Ballast, HLO (.95 < BF < 1.1)	3' 2-Lamp T5	PRS Elec.	2	21	48	15.5
F33GPL/2-H	F21T5	Fluorescent (3) 34" (863mm)T-5 lamps; (2) Prog.Start or PRS Ballasts, HLO (.95 < BF < 1.1)	3' 3-Lamp T5	PRS Elec.	3	21	73	15.5
F34GPL/2-	F21T5	Fluorescent (4) 34" (863mm)T-5 lamps; (2) Prog.Start or PRS Ballasts,	3' 4-Lamp T5	PRS Elec.	4	21	96	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
H		HLO (.95 < BF < 1.1)						
F21GPHL-H	F24T5/HO	Fluorescent (1) 22" (563mm) T-5 HO lamp; (1) Prog.Start or PRS Ballast, HLO (.95 < BF < 1.1)	2' 1-Lamp T5HO	PRS Elec.	1	24	27	15.5
F22GPHL-H	F24T5/HO	Fluorescent (2) 22" (563mm) T-5 HO lamps; (1) Prog.Start or PRS Ballast, HLO (.95 < BF < 1.1)	2' 2-Lamp T5HO	PRS Elec.	2	24	52	15.5
F23GPHL/2-H	F24T5/HO	Fluorescent (3) 22" (563mm)T-5 HO lamps; (2) Prog.Start or PRS Ballasts, HLO (.95 < BF < 1.1)	2' 3-Lamp T5HO	PRS Elec.	3	24	79	15.5
F24GPHL/2-H	F24T5/HO	Fluorescent (4) 22" (563mm)T-5 HO lamps; (2) Prog.Start or PRS Ballasts, HLO (.95 < BF < 1.1)	2' 4-Lamp T5HO	PRS Elec.	4	24	104	15.5
F26GPHL/3-H	F24T5/HO	Fluorescent (4) 22" (563mm) T-5 HO lamps; (3) Prog.Start or PRS Ballasts, HLO (.95 < BF < 1.1)	2' 6-Lamp T5HO	PRS Elec.	6	24	156	15.5
F41GPL-H	F28T5	Fluorescent (1) 45.8" (1163mm) T-5 lamp; (1) PRS Electronic Ballast, HLO (.95 < BF < 1.1)	4' 1-Lamp T5	PRS Elec.	1	28	33	15.5
F41GPL/T2-H	F28T5	Fluorescent (1) 45.8" (1163mm) T-5 lamp; Tandem 2-lamp PRS Ballast,HLO (.95 < BF < 1.1)	4' 1-Lamp T5	PRS Elec.	1	28	32	15.5
F42GPL-H	F28T5	Fluorescent (2) 45.8" (1163mm) T-5 lamps; (1) PRS Electronic Ballast, HLO (.95 < BF < 1.1)	4' 2-Lamp T5	PRS Elec.	2	28	63	15.5
F43GPL/2-H	F28T5	Fluorescent (3) 45.8" (1163mm)T-5 lamps; (2) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 3-Lamp T5	PRS Elec.	3	28	96	15.5
F44GPL/2-H	F28T5	Fluorescent (4) 45.8" (1163mm)T-5 lamps; (2) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 4-Lamp T5	PRS Elec.	4	28	126	15.5
F51GPL-H	F35T5	Fluorescent (1) 57.6" (1463mm) T-5 lamp; (1) Prog.Start or PRS Ballast, HLO (.95 < BF < 1.1)	5' 1-Lamp T5	PRS Elec.	1	35	40	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F52GPL-H	F35T5	Fluorescent (2) 57.6" (1463mm) T-5 lamps; (1) Prog.Start or PRS Ballast, HLO (.95 < BF < 1.1)	5' 2-Lamp T5	PRS Elec.	2	35	78	15.5
F53GPL/2-H	F35T5	Fluorescent (3) 57.6" (1463mm)T-5 lamps; (2) Prog.Start or PRS Ballasts, HLO (.95 < BF < 1.1)	5' 3-Lamp T5	PRS Elec.	3	35	118	15.5
F54GPL/2-H	F35T5	Fluorescent (4) 57.6" (1463mm)T-5 lamps; (2) Prog.Start or PRS Ballasts, HLO (.95 < BF < 1.1)	5' 4-Lamp T5	PRS Elec.	4	35	156	15.5
F31GPHL-H	F39T5/HO	Fluorescent (1) 34" (863mm) T-5 HO lamp; (1) Prog.Start or PRS Ballast, HLO (.95 < BF < 1.1)	3' 1-Lamp T5	PRS Elec.	1	39	44	15.5
F32GPHL-H	F39T5/HO	Fluorescent (2) 34" (863mm) T-5 HO lamps; (1) Prog.Start or PRS Ballast, HLO (.95 < BF < 1.1)	3' 2-Lamp T5	PRS Elec.	2	39	86	15.5
F33GPHL/2-H	F39T5/HO	Fluorescent (3) 34" (863mm)T-5 HO lamps; (2) Prog.Start or PRS Ballasts, HLO (.95 < BF < 1.1)	3' 3-Lamp T5	PRS Elec.	3	39	130	15.5
F34GPHL/2-H	F39T5/HO	Fluorescent (4) 34" (863mm)T-5 HO lamps; (2) Prog.Start or PRS Ballasts, HLO (.95 < BF < 1.1)	3' 4-Lamp T5	PRS Elec.	4	39	172	15.5
F46GPRL/2-H	F45T5/HO-RW	Fluorescent, (6) 45.8" T-5 HO reduced-wattage lamps, (2) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 6-Lamp T5HO	PRS Elec.	6	54	332	15.5
F46GPRL/3-H	F45T5/HO-RW	Fluorescent, (6) 45.8" T-5 HO reduced-wattage lamps, (3) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 6-Lamp T5HO	PRS Elec.	6	54	330	15.5
F41GPHL-H	F54T5/HO	Fluorescent (1) 45.8" T-5 HO lamp, (1) PRS Electronic Ballast, HLO (.95 < BF < 1.1)	4' 1-Lamp T5HO	PRS Elec.	1	54	64	15.5
F41GPHL/T2-H	F54T5/HO	Fluorescent (1) 45.8" T-5 HO lamp, Tandem 2-lamp PRS Ballast, HLO (.95 < BF < 1.1)	4' 1-Lamp T5HO	PRS Elec.	1	54	59	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F42GPHL-H	F54T5/HO	Fluorescent (2) 45.8" T-5 HO lamps, (1) PRS Electronic Ballast, HLO (.95 < BF < 1.1)	4' 2-Lamp T5HO	PRS Elec.	2	54	117	15.5
F43GPHL-H	F54T5/HO	Fluorescent, (3) 45.8" T-5 HO lamps, (1) PRS Electronic Ballast, HLO (.95 < BF < 1.1)	4' 3-Lamp T5HO	PRS Elec.	3	54	181	15.5
F43GPHL/2-H	F54T5/HO	Fluorescent (3) 45.8" T-5 HO lamps, (2) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 3-Lamp T5HO	PRS Elec.	3	54	181	15.5
F44GPHL-H	F54T5/HO	Fluorescent, (4) 45.8" T-5 HO lamps, (1) PRS Electronic Ballast, HLO (.95 < BF < 1.1)	4' 4-Lamp T5HO	PRS Elec.	4	54	230	15.5
F44GPHL/2-H	F54T5/HO	Fluorescent (4) 45.8" T-5 HO lamps, (2) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 4-Lamp T5HO	PRS Elec.	4	54	234	15.5
F45GPHL/2-H	F54T5/HO	Fluorescent (5) 45.8" T-5 HO lamps, (2) PRS Electronic Ballast, HLO (.95 < BF < 1.1)	4' 5-Lamp T5HO	PRS Elec.	5	54	298	15.5
F45GPRL/2-H	F54T5/HO-RW	Fluorescent (5) 45.2" T-5 HO reduced-wattage lamp, (2) PRS Electronic Ballast, HLO (.95 < BF < 1.1)	4' 5-Lamp T5HO	PRS Elec.	5	47-51	276	15.5
F46GPHL/2-H	F54T5/HO	Fluorescent, (6) 45.8" T-5 HO lamps, (2) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 6-Lamp T5HO	PRS Elec.	6	54	362	15.5
F46GPHL/3-H	F54T5/HO	Fluorescent, (6) 45.8" T-5 HO lamps, (3) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 6-Lamp T5HO	PRS Elec.	6	54	351	15.5
F48GPHL/2-H	F54T5/HO	Fluorescent, (8) 45.8" T-5 HO lamps, (2) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 8-Lamp T5HO	PRS Elec.	8	54	460	15.5
F48GPHL/4-H	F54T5/HO	Fluorescent, (8) 45.8" T-5 HO lamps, (4) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 8-Lamp T5HO	PRS Elec.	8	54	468	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F410GPHL /3-H	F54T5/HO	Fluorescent, (10) 45.8" T-5 HO lamps, (3) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 10L T5HO	PRS Elec.	10	54	577	15.5
F410GPHL /5-H	F54T5/HO	Fluorescent, (10) 45.8" T-5 HO lamps, (5) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 10L T5HO	PRS Elec.	10	54	585	15.5
F412GPHL /3-H	F54T5/HO	Fluorescent, (12) 45.8" T-5 HO lamps, (3) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 12 T5HO	PRS Elec.	12	54	690	15.5
F412GPHL /6-H	F54T5/HO	Fluorescent, (12) 45.8" T-5 HO lamps, (6) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 12-Lamp T5HO	PRS Elec.	12	54	702	15.5
F41GPRL-H	F54T5/HO-RW	Fluorescent (1) 45.2" T-5 HO reduced-wattage lamp, (1) PRS Electronic Ballast, HLO (.95 < BF < 1.1)	4' 1-Lamp T5HO	PRS Elec.	1	47-51	61	15.5
F42GPRL-H	F54T5/HO-RW	Fluorescent (2) 45.2" T-5 HO reduced-wattage lamp, (1) PRS Electronic Ballast, HLO (.95 < BF < 1.1)	4' 2-Lamp T5HO	PRS Elec.	2	47-51	110	15.5
F43GPRL-H	F54T5/HO-RW	Fluorescent (3) 45.2" T-5 HO reduced-wattage lamp, (1) PRS Electronic Ballast, HLO (.95 < BF < 1.1)	4' 3-Lamp T5HO	PRS Elec.	3	47-51	166	15.5
F44GPRL-H	F54T5/HO-RW	Fluorescent (4) 45.2" T-5 HO reduced-wattage lamp, (1) PRS Electronic Ballast, HLO (.95 < BF < 1.1)	4' 4-Lamp T5HO	PRS Elec.	4	47-51	211	15.5
F48GPRL/2-H	F54T5/HO-RW	Fluorescent, (8) 45.8" T-5 HO reduced-wattage lamps, (2) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 8-Lamp T5HO	PRS Elec.	8	50	428	15.5
F48GPRL/4-H	F54T5/HO-RW	Fluorescent, (8) 45.8" T-5 HO reduced-wattage lamps, (4) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 8-Lamp T5HO	PRS Elec.	8	50	436	15.5
F410GPRL /3-H	F54T5/HO-RW	Fluorescent, (10) 45.8" T-5 HO reduced-wattage lamps, (3) PRS Electronic Ballast, HLO (.95 < BF < 1.1)	4' 10L T5HO	PRS Elec.	10	50	537	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F410GPRL /5-H	F54T5/HO-RW	Fluorescent, (10) 45.8" T-5 HO reduced-wattage lamps, (5) PRS Electronic Ballast, HLO (.95 < BF < 1.1)	4' 10L T5HO	PRS Elec.	10	50	545	15.5
F412GPRL /3-H	F54T5/HO-RW	Fluorescent, (12) 45.8" T-5 HO reduced-wattage lamps, (3) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 12-Lamp T5HO	PRS Elec.	12	50	642	15.5
F412GPRL /6-H	F54T5/HO-RW	Fluorescent, (12) 45.8" T-5 HO reduced-wattage lamps, (6) PRS Electronic Ballasts, HLO (.95 < BF < 1.1)	4' 12-Lamp T5HO	PRS Elec.	12	50	654	15.5
F51GPHL-H	F80T5/HO	Fluorescent (1) 57.6" (1463mm) T-5 HO lamp; (1) Prog.Start or PRS Ballast, HLO (.95 < BF < 1.1)	5' 1-Lamp T5HO	PRS Elec.	1	80	90	15.5
F52GPHL/ 2-H	F80T5/HO	Fluorescent (2) 57.6" (1463mm) T-5 HO lamps; (1) Prog.Start or PRS Ballast, HLO (.95 < BF < 1.1)	5' 2-Lamp T5HO	PRS Elec.	2	80	180	15.5
FT8		T8 Linear Fluorescent Systems						
F1.51LS	F15T8	Fluorescent, (1) 18" T-8 lamp	1.5' 1-Lamp T8	Mag-STD	1	15	19	15.5
F1.52LS	F15T8	Fluorescent, (2) 18" T-8 lamps	1.5' 2-Lamp T8	Mag-STD	2	15	36	15.5
F21GLL	F17T8	Fluorescent (1) 24" T-8 lamp, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	2' 1-Lamp T8	PRS Elec.	1	17	18	15.5
F21ILL	F17T8	Fluorescent, (1) 24", T-8 lamp, Instant Start Ballast, NLO (0.85 < BF < 0.95)	2' 1-Lamp T8	Electronic	1	17	18	15.5
F21ILL-R	F17T8	Fluorescent, (1) 24", T-8 lamp, Instant Start Ballast, RLO (BF< 0.85)	2' 1-Lamp T8 RLO	Electronic	1	17	17	15.5
F21ILL/T2	F17T8	Fluorescent, (1) 24", T-8 lamp, Tandem 2-lamp IS Ballast, NLO (0.85 < BF < 0.95)	2' 1-Lamp T8	Electronic	1	17	17	15.5
F21ILL/T2-	F17T8	Fluorescent, (1) 24", T-8 lamp, Tandem 2-lamp IS Ballast, RLO (BF<	2' 1-Lamp T8 RLO	Electronic	1	17	15	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
R		0.85)						
F21ILL/T3	F17T8	Fluorescent, (1) 24", T-8 lamp, Tandem 3-lamp IS Ballast, NLO (0.85 < BF < 0.95)	2' 1-Lamp T8	Electronic	1	17	16	15.5
F21ILL/T3-R	F17T8	Fluorescent, (1) 24", T-8 lamp, Tandem 3-lamp IS Ballast, RLO (BF< 0.85)	2' 1-Lamp T8 RLO	Electronic	1	17	14	15.5
F21ILL/T4	F17T8	Fluorescent, (1) 24", T-8 lamp, Tandem 4-lamp IS Ballast, NLO (0.85 < BF < 0.95)	2' 1-Lamp T8	Electronic	1	17	15	15.5
F21ILL/T4-R	F17T8	Fluorescent, (1) 24", T-8 lamp, Tandem 4-lamp IS Ballast, RLO (BF< 0.85)	2' 1-Lamp T8 RLO	Electronic	1	17	13	15.5
F21ILU	F17T8	Fluorescent, (1) 24", T-8 lamp, Instant Start Ballast, NLO (0.85 < BF < 0.95)	2' 1-Lamp T8	Electronic	1	17	17	15.5
F21ILU-R	F17T8	Fluorescent, (1) 24", T-8 lamp, Instant Start Ballast, RLO (BF< 0.85)	2' 1-Lamp T8 RLO	Electronic	1	17	15	15.5
F21ILU-V	F17T8	Fluorescent, (1) 24", T-8 lamps, Instant Start Ballast, VHLO (BF > 1.1)	2' 1-Lamp T8 VHLO	Electronic	1	17	22	15.5
F21LL	F17T8	Fluorescent, (1) 24", T-8 lamp, Rapid Start Ballast, NLO (0.85 < BF < 0.95)	2' 1-Lamp T8	Electronic	1	17	16	15.5
F21LL-R	F17T8	Fluorescent, (1) 24", T-8 lamp, Rapid Start Ballast, RLO (BF< 0.85)	2' 1-Lamp T8 RLO	Electronic	1	17	15	15.5
F21LL/T2	F17T8	Fluorescent, (1) 24", T-8 lamp, Tandem 2-Lamp RS Ballast, NLO (0.85 < BF < 0.95)	2' 1-Lamp T8	Electronic	1	17	16	15.5
F21LL/T3	F17T8	Fluorescent, (1) 24", T-8 lamp, Tandem 3-Lamp RS Ballast, NLO (0.85 < BF < 0.95)	2' 1-Lamp T8	Electronic	1	17	17	15.5
F21LL/T4	F17T8	Fluorescent, (1) 24", T-8 lamp, Tandem 4-Lamp RS Ballast, NLO (0.85 < BF < 0.95)	2' 1-Lamp T8	Electronic	1	17	17	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F21SL	F17T8	Fluorescent, (1) 24", T-8 lamp, Standard Ballast	2' 1-Lamp T8	Mag-STD	1	17	24	15.5
F22GLL	F17T8	Fluorescent (2) 24" T-8 lamp, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	2' 2-Lamp T8	PRS Elec.	2	17	31	15.5
F22ILL	F17T8	Fluorescent, (2) 24", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	2' 2-Lamp T8	Electronic	2	17	33	15.5
F22ILL-R	F17T8	Fluorescent, (2) 24", T-8 lamps, Instant Start Ballast, RLO (BF< 0.85)	2' 2-Lamp T8 RLO	Electronic	2	17	30	15.5
F22ILL/T4	F17T8	Fluorescent, (2) 24", T-8 lamps, Tandem 4-lamp IS Ballast, NLO (0.85 < BF < 0.95)	2' 2-Lamp T8	Electronic	2	17	30	15.5
F22ILL/T4-R	F17T8	Fluorescent, (2) 24", T-8 lamps, Tandem 4-lamp IS Ballast, RLO (BF<.85)	2' 2-Lamp T8 RLO	Electronic	2	17	27	15.5
F22ILU	F17T8	Fluorescent, (2) 24", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	2' 2-Lamp T8	Electronic	2	17	30	15.5
F22ILU-R	F17T8	Fluorescent, (2) 24", T-8 lamps, Instant Start Ballast, RLO (BF< 0.85)	2' 2-Lamp T8 RLO	Electronic	2	17	27	15.5
F22ILU-V	F17T8	Fluorescent, (2) 24", T-8 lamps, Instant Start Ballast, VHLO (BF > 1.1)	2' 2-Lamp T8 VHLO	Electronic	2	17	41	15.5
F22ILU/T4-R	F17T8	Fluorescent, (2) 24", T-8 lamps, Tandem 4-lamp IS Ballast, RLO (BF< 0.85)	2' 2-Lamp T8 RLO	Electronic	2	17	26	15.5
F22LL	F17T8	Fluorescent, (2) 24", T-8 lamps, Rapid Start Ballast, NLO (0.85 < BF < 0.95)	2' 2-Lamp T8	Electronic	2	17	31	15.5
F22LL-R	F17T8	Fluorescent, (2) 24", T-8 lamps, Rapid Start Ballast, RLO (BF< 0.85)	2' 2-Lamp T8 RLO	Electronic	2	17	28	15.5
F22LL/T4	F17T8	Fluorescent, (2) 24", T-8 lamps, Tandem 4-lamp RS Ballast, NLO (0.85 < BF < 0.95)	2' 2-Lamp T8	Electronic	2	17	34	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F23GLL	F17T8	Fluorescent (3) 24" T-8 lamp, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	2' 3-Lamp T8	PRS Elec.	3	17	47	15.5
F23ILL	F17T8	Fluorescent, (3) 24", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	2' 3-Lamp T8	Electronic	3	17	47	15.5
F23ILL-H	F17T8	Fluorescent, (3) 24", T-8 lamps, Instant Start Ballast, HLO (0.95 < BF < 1.1)	2' 3-Lamp T8 HLO	Electronic	3	17	51	15.5
F23ILL-R	F17T8	Fluorescent, (3) 24", T-8 lamps, Instant Start Ballast, RLO (BF< 0.85)	2' 3-Lamp T8 RLO	Electronic	3	17	41	15.5
F23ILU	F17T8	Fluorescent, (3) 24", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	2' 3-Lamp T8	Electronic	3	17	45	15.5
F23ILU-R	F17T8	Fluorescent, (3) 24", T-8 lamps, Instant Start Ballast, RLO (BF< 0.85)	2' 3-Lamp T8 RLO	Electronic	3	17	40	15.5
F23ILU-V	F17T8	Fluorescent, (3) 24", T-8 lamps, Instant Start Ballast, VHLO (BF > 1.1)	2' 3-Lamp T8 VHLO	Electronic	3	17	59	15.5
F23LL	F17T8	Fluorescent, (3) 24", T-8 lamps, Rapid Start Ballast, NLO (0.85 < BF < 0.95)	2' 3-Lamp T8	Electronic	3	17	52	15.5
F23LL-R	F17T8	Fluorescent, (3) 24", T-8 lamps, Rapid Start Ballast, RLO (BF< 0.85)	2' 3-Lamp T8 RLO	Electronic	3	17	41	15.5
F24GLL	F17T8	Fluorescent (4) 24" T-8 lamp, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	2' 4-Lamp T8	PRS Elec.	4	17	59	15.5
F24ILL	F17T8	Fluorescent, (4) 24", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	2' 4-Lamp T8	Electronic	4	17	59	15.5
F24ILL-R	F17T8	Fluorescent, (4) 24", T-8 lamps, Instant Start Ballast, RLO (BF< 0.85)	2' 4-Lamp T8 RLO	Electronic	4	17	53	15.5
F24ILU	F17T8	Fluorescent, (4) 24", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	2' 4-Lamp T8	Electronic	4	17	57	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F24ILU-R	F17T8	Fluorescent, (4) 24", T-8 lamps, Instant Start Ballast, RLO (BF< 0.85)	2' 4-Lamp T8 RLO	Electronic	4	17	52	15.5
F24LL	F17T8	Fluorescent, (4) 24", T-8 lamps, Rapid Start Ballast, NLO (0.85 < BF < 0.95)	2' 4-Lamp T8	Electronic	4	17	68	15.5
F24LL-R	F17T8	Fluorescent, (4) 24", T-8 lamps, Rapid Start Ballast, RLO (BF< 0.85)	2' 4-Lamp T8 RLO	Electronic	4	17	57	15.5
F31ILL	F25T8	Fluorescent, (1) 36", T-8 lamp, Instant Start Ballast, NLO (0.85 < BF < 0.95)	3' 1-Lamp T8	Electronic	1	25	26	15.5
F31ILL-H	F25T8	Fluorescent, (1) 36", T-8 lamp, Instant Start Ballast, HLO (0.95 < BF < 1.1)	3' 1-Lamp T8 HLO	Electronic	1	25	28	15.5
F31ILL-R	F25T8	Fluorescent, (1) 36", T-8 lamp, Instant Start Ballast, RLO (BF< 0.85)	3' 1-Lamp T8 RLO	Electronic	1	25	22	15.5
F31ILL/T2	F25T8	Fluorescent, (1) 36", T-8 lamp, Tandem 2-lamp IS Ballast, NLO (0.85 < BF < 0.95)	3' 1-Lamp T8	Electronic	1	25	23	15.5
F31ILL/T2-H	F25T8	Fluorescent, (1) 36", T-8 lamp, Tandem 3-lamp IS Ballast, 1 lead capped, HLO (0.95 < BF < 1.1)	3' 1-Lamp T8	Electronic	1	25	26	15.5
F31ILL/T2-R	F25T8	Fluorescent, (1) 36", T-8 lamp, Tandem 2-lamp IS Ballast, RLO (BF< 0.85)	3' 1-Lamp T8 RLO	Electronic	1	25	21	15.5
F31ILL/T3	F25T8	Fluorescent, (1) 36", T-8 lamp, Tandem 3-lamp IS Ballast, NLO (0.85 < BF < 0.95)	3' 1-Lamp T8	Electronic	1	25	23	15.5
F31ILL/T3-R	F25T8	Fluorescent, (1) 36", T-8 lamp, Tandem 3-lamp IS Ballast, RLO (BF< 0.85)	3' 1-Lamp T8 RLO	Electronic	1	25	20	15.5
F31ILL/T4	F25T8	Fluorescent, (1) 36", T-8 lamp, Tandem 4-lamp IS Ballast, NLO (0.85 < BF < 0.95)	3' 1-Lamp T8	Electronic	1	25	22	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F31ILL/T4-R	F25T8	Fluorescent, (1) 36", T-8 lamp, Tandem 4-lamp IS Ballast, RLO (BF< 0.85)	3' 1-Lamp T8 RLO	Electronic	1	25	20	15.5
F31ILU	F25T8	Fluorescent, (1) 36", T-8 lamp, Instant Start Ballast, NLO (0.85 < BF < 0.95)	3' 1-Lamp T8	Electronic	1	25	23	15.5
F31ILU-R	F25T8	Fluorescent, (1) 36", T-8 lamp, Instant Start Ballast, RLO (BF< 0.85)	3' 1-Lamp T8 RLO	Electronic	1	25	20	15.5
F31ILU/T2	F25T8	Fluorescent, (1) 36", T-8 lamp, Tandem 2-lamp IS Ballast, NLO (0.85 < BF < 0.95)	3' 1-Lamp T8	Electronic	1	25	22	15.5
F31ILU/T2-R	F25T8	Fluorescent, (1) 36", T-8 lamp, Tandem 2-lamp IS Ballast, RLO (BF< 0.85)	3' 1-Lamp T8 RLO	Electronic	1	25	20	15.5
F31ILU/T3-R	F25T8	Fluorescent, (1) 36", T-8 lamp, Tandem 3-lamp IS Ballast, RLO (BF< 0.85)	3' 1-Lamp T8 RLO	Electronic	1	25	19	15.5
F31ILU/T4-R	F25T8	Fluorescent, (1) 36", T-8 lamp, Tandem 4-lamp IS Ballast, RLO (BF< 0.85)	3' 1-Lamp T8 RLO	Electronic	1	25	19	15.5
F31LL	F25T8	Fluorescent, (1) 36", T-8 lamp, Rapid Start Ballast, NLO (0.85 < BF < 0.95)	3' 1-Lamp T8	Electronic	1	25	24	15.5
F31LL-H	F25T8	Fluorescent, (1) 36", T-8 lamp, Rapid Start Ballast, HLO (0.95 < BF < 1.1)	3' 1-Lamp T8 HLO	Electronic	1	25	26	15.5
F31LL-R	F25T8	Fluorescent, (1) 36", T-8 lamp, Rapid Start Ballast, RLO (BF< 0.85)	3' 1-Lamp T8 RLO	Electronic	1	25	23	15.5
F31LL/T2	F25T8	Fluorescent, (1) 36", T-8 lamp, Tandem 2-lamp RS Ballast, NLO (0.85 < BF < 0.95)	3' 1-Lamp T8	Electronic	1	25	23	15.5
F31LL/T3	F25T8	Fluorescent, (1) 36", T-8 lamp, Tandem 3-lamp RS Ballast, NLO (0.85 < BF < 0.95)	3' 1-Lamp T8	Electronic	1	25	24	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F31LL/T4	F25T8	Fluorescent, (1) 36", T-8 lamp, Tandem 4-lamp RS Ballast, NLO (0.85 < BF < 0.95)	3' 1-Lamp T8	Electronic	1	25	22	15.5
F32ILL	F25T8	Fluorescent, (2) 36", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	3' 2-Lamp T8	Electronic	2	25	46	15.5
F32ILL-H	F25T8	Fluorescent, (2) 36", T-8 lamps, Instant Start Ballast, HLO (0.95 < BF < 1.1)	3' 2-Lamp T8 HLO	Electronic	2	25	52	15.5
F32ILL-R	F25T8	Fluorescent, (2) 36", T-8 lamps, Instant Start Ballast, RLO (BF< 0.85)	3' 2-Lamp T8 RLO	Electronic	2	25	42	15.5
F32ILL/2-R	F25T8	Fluorescent, (2) 36", T-8 lamps, (2) Instant Start Ballasts, RLO (BF< 0.85)	3' 2-Lamp T8 RLO	Electronic	2	25	44	15.5
F32ILL/T4	F25T8	Fluorescent, (2) 36", T-8 lamps, Tandem 4-lamp IS Ballast, NLO (0.85 < BF < 0.95)	3' 2-Lamp T8	Electronic	2	25	44	15.5
F32ILL/T4-R	F25T8	Fluorescent, (2) 36", T-8 lamps, Tandem 4-lamp IS Ballast, RLO (BF< 0.85)	3' 2-Lamp T8 RLO	Electronic	2	25	39	15.5
F32ILU	F25T8	Fluorescent, (2) 36", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	3' 2-Lamp T8	Electronic	2	25	44	15.5
F32ILU-R	F25T8	Fluorescent, (2) 36", T-8 lamps, Instant Start Ballast, RLO (BF< 0.85)	3' 2-Lamp T8 RLO	Electronic	2	25	39	15.5
F32ILU/T4-R	F25T8	Fluorescent, (2) 36", T-8 lamps, Tandem 4-lamp IS Ballast, RLO (BF< 0.85)	3' 2-Lamp T8 RLO	Electronic	2	25	39	15.5
F32LL	F25T8	Fluorescent, (2) 36", T-8 lamps, Rapid Start Ballast, NLO (0.85 < BF < 0.95)	3' 2-Lamp T8	Electronic	2	25	46	15.5
F32LL-H	F25T8	Fluorescent, (2) 36", T-8 lamps, Rapid Start Ballast, HLO (0.95 < BF < 1.1)	3' 2-Lamp T8 HLO	Electronic	2	25	50	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F32LL-R	F25T8	Fluorescent, (2) 36", T-8 lamps, Rapid Start Ballast, RLO (BF< 0.85)	3' 2-Lamp T8 RLO	Electronic	2	25	42	15.5
F32LL-V	F25T8	Fluorescent, (2) 36", T-8 lamps, Rapid Start Ballast, VHLO (BF > 1.1)	3' 2-Lamp T8 VHLO	Electronic	2	25	70	15.5
F32LL/T4	F25T8	Fluorescent, (2) 36", T-8 lamps, Tandem 4-lamp RS Ballast, NLO (0.85 < BF < 0.95)	3' 2-Lamp T8	Electronic	2	25	45	15.5
F33ILL	F25T8	Fluorescent, (3) 36", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	3' 3-Lamp T8	Electronic	3	25	68	15.5
F33ILL-R	F25T8	Fluorescent, (3) 36", T-8 lamps, Instant Start Ballast, RLO (BF< 0.85)	3' 3-Lamp T8 RLO	Electronic	3	25	61	15.5
F33ILU	F25T8	Fluorescent, (3) 36", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	3' 3-Lamp T8	Electronic	3	25	65	15.5
F33ILU-R	F25T8	Fluorescent, (3) 36", T-8 lamps, Instant Start Ballast, RLO (BF< 0.85)	3' 3-Lamp T8 RLO	Electronic	3	25	58	15.5
F33LL	F25T8	Fluorescent, (3) 36", T-8 lamps, Rapid Start Ballast, NLO (0.85 < BF < 0.95)	3' 3-Lamp T8	Electronic	3	25	72	15.5
F33LL-R	F25T8	Fluorescent, (3) 36", T-8 lamps, Rapid Start Ballast, RLO (BF< 0.85)	3' 3-Lamp T8 RLO	Electronic	3	25	62	15.5
F34ILL	F25T8	Fluorescent, (4) 36", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	3' 4-Lamp T8	Electronic	4	25	88	15.5
F34ILL-R	F25T8	Fluorescent, (4) 36", T-8 lamps, Instant Start Ballast, RLO (BF< 0.85)	3' 4-Lamp T8 RLO	Electronic	4	25	78	15.5
F34ILL/2-R	F25T8	Fluorescent, (4) 36", T-8 lamps, (2) Instant Start Ballasts, RLO (BF< 0.85)	3' 4-Lamp T8 RLO	Electronic	4	25	84	15.5
F34ILU	F25T8	Fluorescent, (4) 36", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	3' 4-Lamp T8	Electronic	4	25	86	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F34ILU-R	F25T8	Fluorescent, (4) 36", T-8 lamps, Instant Start Ballast, RLO (BF< 0.85)	3' 4-Lamp T8 RLO	Electronic	4	25	77	15.5
F34LL	F25T8	Fluorescent, (4) 36", T-8 lamps, Rapid Start Ballast, NLO (0.85 < BF < 0.95)	3' 4-Lamp T8	Electronic	4	25	89	15.5
F34LL-R	F25T8	Fluorescent, (4) 36", T-8 lamps, Rapid Start Ballast, RLO (BF< 0.85)	3' 4-Lamp T8 RLO	Electronic	4	25	84	15.5
F36ILL/2	F25T8	Fluorescent, (6) 36", T-8 lamps, (2) Instant Start Ballasts, NLO (0.85 < BF < 0.95)	3' 6-Lamp T8	Electronic	6	25	135	15.5
F36ILL/2-R	F25T8	Fluorescent, (6) 36", T-8 lamps, (2) Instant Start Ballasts, RLO (BF< 0.85)	3' 6-Lamp T8 RLO	Electronic	6	25	121	15.5
F42GRLL-V	F28T8	Fluorescent, (2) 48", T-8 lamps, Prog. Start or PRS Ballast, VHLO (BF > 1.1)	4' 2-Lamp T8 28W VLHO	PRS Elec.	2	28	66	15.5
F43GRLL-V	F28T8	Fluorescent, (3) 48", T-8 lamps, Prog. Start or PRS Ballast, VHLO (BF > 1.1)	4' 3-Lamp T8 28W VLHO	PRS Elec.	3	28	92	15.5
F41GLL	F32T8	Fluorescent (1) 48" T-8 lamp, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8	PRS Elec.	1	32	30	15.5
F41GLL-R	F32T8	Fluorescent (1) 48" T-8 lamp, Prog. Start or PRS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 RLO	PRS Elec.	1	32	25	15.5
F41ILL	F32T8	Fluorescent, (1) 48", T-8 lamp, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8	Electronic	1	32	31	15.5
F41ILL-H	F32T8	Fluorescent, (1) 48", T-8 lamp, Instant Start Ballast, HLO (0.95 < BF < 1.1)	4' 1-Lamp T8 HLO	Electronic	1	32	36	15.5
F41ILL-R	F32T8	Fluorescent, (1) 48", T-8 lamp, Instant Start Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 RLO	Electronic	1	32	27	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F41ILL/T2	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 2-lamp IS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8	Electronic	1	32	29	15.5
F41ILL/T2-H	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 3-lamp IS Ballast, 1 lead capped, HLO (0.95 < BF < 1.1)	4' 1-Lamp T8 HLO	Electronic	1	32	33	15.5
F41ILL/T2-R	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 2-lamp IS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 RLO	Electronic	1	32	26	15.5
F41ILL/T3	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 3-lamp IS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8	Electronic	1	32	28	15.5
F41ILL/T3-H	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 4-lamp IS Ballast, 1 lead capped, HLO (0.95 < BF < 1.1)	4' 1-Lamp T8 HLO	Electronic	1	32	31	15.5
F41ILL/T3-R	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 3-lamp IS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 RLO	Electronic	1	32	25	15.5
F41ILL/T4	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 4-lamp IS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8	Electronic	1	32	28	15.5
F41ILL/T4-R	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 4-lamp IS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 RLO	Electronic	1	32	25	15.5
F41ILU	F32T8	Fluorescent, (1) 48", T-8 lamp, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8	Electronic	1	32	28	15.5
F41ILU-H	F32T8	Fluorescent, (1) 48", T-8 lamp, Instant Start Ballast, HLO (0.95 < BF < 1.1)	4' 1-Lamp T8 HLO	Electronic	1	32	35	15.5
F41ILU-R	F32T8	Fluorescent, (1) 48", T-8 lamp, Instant Start Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 RLO	Electronic	1	32	25	15.5
F41ILU/T2	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 2-lamp IS Ballast, NLO (0.85 <	4' 1-Lamp T8	Electronic	1	32	27	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
		BF < 0.95)						
F41ILU/T2-R	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 2-lamp IS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 RLO	Electronic	1	32	24	15.5
F41ILU/T3	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 3-lamp IS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8	Electronic	1	32	27	15.5
F41ILU/T3-R	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 3-lamp IS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 RLO	Electronic	1	32	24	15.5
F41ILU/T4	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 4-lamp IS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8	Electronic	1	32	27	15.5
F41ILU/T4-R	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 4-lamp IS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 RLO	Electronic	1	32	24	15.5
F41LE	F32T8	Fluorescent, (1) 48", T-8 lamp	4' 1-Lamp T8	Mag-ES	1	32	35	15.5
F41LL	F32T8	Fluorescent, (1) 48", T-8 lamp, Rapid Start Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8	Electronic	1	32	32	15.5
F41LL-H	F32T8	Fluorescent, (1) 48", T-8 lamp, Rapid Start Ballast, HLO (0.95 < BF < 1.1)	4' 1-Lamp T8 HLO	Electronic	1	32	39	15.5
F41LL-R	F32T8	Fluorescent, (1) 48", T-8 lamp, Rapid Start Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 RLO	Electronic	1	32	27	15.5
F41LL/T2	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 2-lamp RS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8	Electronic	1	32	30	15.5
F41LL/T2-H	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 3-lamp RS Ballast, 1 lead capped, HLO (0.95 < BF < 1.1)	4' 1-Lamp T8 HLO	Electronic	1	32	35	15.5
F41LL/T2-	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 2-lamp RS Ballast, RLO (BF<	4' 1-Lamp T8 RLO	Electronic	1	32	27	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
R		0.85)						
F41LL/T3	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 3-lamp RS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8	Electronic	1	32	31	15.5
F41LL/T3-H	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 4-lamp RS Ballast, 1 lead capped, HLO (0.95 < BF < 1.1)	4' 1-Lamp T8 HLO	Electronic	1	32	33	15.5
F41LL/T3-R	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 3-lamp RS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 RLO	Electronic	1	32	25	15.5
F41LL/T4	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 4-lamp RS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8	Electronic	1	32	30	15.5
F41LL/T4-R	F32T8	Fluorescent, (1) 48", T-8 lamp, Tandem 4-lamp RS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 RLO	Electronic	1	32	26	15.5
F42GLL	F32T8	Fluorescent (2) 48" T-8 lamps, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8	PRS Elec.	2	32	59	15.5
F42GLL-R	F32T8	Fluorescent (2) 48" T-8 lamps, Prog. Start or PRS Ballast, RLO (BF < 0.85)	4' 2-Lamp T8 RLO	PRS Elec.	2	32	47	15.5
F42GLL-V	F32T8	Fluorescent, (2) 48" T-8 lamps, Prog. Start or PRS Ballast, VHLO (BF > 1.1)	4' 2-Lamp T8 VHLO	PRS Elec.	2	32	74	15.5
F42ILL	F32T8	Fluorescent, (2) 48", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8	Electronic	2	32	58	15.5
F42ILL-H	F32T8	Fluorescent, (2) 48", T-8 lamp, Instant Start Ballast, HLO (0.95 < BF < 1.1)	4' 2-Lamp T8 HLO	Electronic	2	32	66	15.5
F42ILL-R	F32T8	Fluorescent, (2) 48", T-8 lamps, Instant Start Ballast, RLO (BF< 0.85)	4' 2-Lamp T8 RLO	Electronic	2	32	51	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F42ILL-V	F32T8	Fluorescent, (2) 48", T-8 lamps, Instant Start Ballast, VHLO (BF > 1.1)	4' 2-Lamp T8 VHLO	Electronic	2	32	77	15.5
F42ILL/2	F32T8	Fluorescent, (2) 48", T-8 lamps, (2) 1-lamp Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8	Electronic	2	32	62	15.5
F42ILL/2-R	F32T8	Fluorescent, (2) 48" T-8 lamps, (2) 1-lamp Instant Start Ballasts, RLO (BF< 0.85)	4' 2-Lamp T8 RLO	Electronic	2	32	54	15.5
F42ILL/T4	F32T8	Fluorescent, (2) 48", T-8 lamps, Tandem 4-lamp IS Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8	Electronic	2	32	56	15.5
F42ILL/T4-R	F32T8	Fluorescent, (2) 48", T-8 lamps, Tandem 4-lamp IS Ballast, RLO (BF< 0.85)	4' 2-Lamp T8 RLO	Electronic	2	32	49	15.5
F42ILU	F32T8	Fluorescent, (2) 48", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8	Electronic	2	32	54	15.5
F42ILU-H	F32T8	Fluorescent, (2) 48", T-8 lamp, Instant Start Ballast, HLO (0.95 < BF < 1.1)	4' 2-Lamp T8 HLO	Electronic	2	32	64	15.5
F42ILU-R	F32T8	Fluorescent, (2) 48", T-8 lamps, Instant Start, RLO (BF< 0.85)	4' 2-Lamp T8 RLO	Electronic	2	32	48	15.5
F42ILU-V	F32T8	Fluorescent, (2) 48", T-8 lamps, Instant Start, VHLO (BF> 1.1)	4' 2-Lamp T8 VHLO	Electronic	2	32	73	15.5
F42ILU/T4	F32T8	Fluorescent, (2) 48", T-8 lamps, Tandem 4-lamp IS Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8	Electronic	2	32	54	15.5
F42ILU/T4-R	F32T8	Fluorescent, (2) 48", T-8 lamps, Tandem 4-lamp IS Ballast, RLO (BF< 0.85)	4' 2-Lamp T8 RLO	Electronic	2	32	48	15.5
F42LE	F32T8	Fluorescent, (2) 48", T-8 lamp	4' 2-Lamp T8	Mag-ES	2	32	71	15.5
F42LL	F32T8	Fluorescent, (2) 48", T-8 lamps, Rapid Start Ballast, NLO (0.85 < BF <	4' 2-Lamp T8	Electronic	2	32	60	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
		0.95)						
F42LL-H	F32T8	Fluorescent, (2) 48", T-8 lamp, Rapid Start Ballast, HLO (0.95 < BF < 1.1)	4' 2-Lamp T8 HLO	Electronic	2	32	70	15.5
F42LL-R	F32T8	Fluorescent, (2) 48", T-8 lamp, Rapid Start Ballast, RLO (BF< 0.85)	4' 2-Lamp T8 RLO	Electronic	2	32	54	15.5
F42LL-V	F32T8	Fluorescent, (2) 48", T-8 lamp, Rapid Start Ballast, VHLO (BF > 1.1)	4' 2-Lamp T8 HLO	Electronic	2	32	85	15.5
F42LL/2	F32T8	Fluorescent, (2) 48", T-8 lamps, (2) 1-lamp Rapid Start Ballasts, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8	Electronic	2	32	64	15.5
F42LL/T4	F32T8	Fluorescent, (2) 48", T-8 lamps, Tandem 4-lamp RS Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8	Electronic	2	32	59	15.5
F42LL/T4-R	F32T8	Fluorescent, (2) 48", T-8 lamp, Tandem 4-lamp RS Ballast, RLO (BF< 0.85)	4' 2-Lamp T8 RLO	Electronic	2	32	53	15.5
F43GLL	F32T8	Fluorescent (3) 48" T-8 lamps, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	4' 3-Lamp T8	PRS Elec.	3	32	88	15.5
F43GLL-R	F32T8	Fluorescent (3) 48" T-8 lamps, Prog. Start or PRS Ballast, RLO (BF < 0.85)	4' 3-Lamp T8 RLO	PRS Elec.	3	32	72	15.5
F43GLL-V	F32T8	Fluorescent, (3) 48" T-8 lamps, Prog. Start or PRS Ballast, VHLO (BF > 1.1)	4' 3-Lamp T8 VHLO	Electronic	3	32	108	15.5
F43ILL	F32T8	Fluorescent, (3) 48" T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 3-Lamp T8	Electronic	3	32	85	15.5
F43ILL-H	F32T8	Fluorescent, (3) 48" T-8 lamps, Instant Start Ballast, HLO (0.95 < BF < 1.1)	4' 3-Lamp T8 HLO	Electronic	3	32	93	15.5
F43ILL-R	F32T8	Fluorescent, (3) 48" T-8 lamps, Instant Start Ballast, RLO (BF < 0.85)	4' 3-Lamp T8 RLO	Electronic	3	32	76	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F43ILL-V	F32T8	Fluorescent, (3) 48" T-8 lamps, Instant Start Ballast, VHLO (BF > 1.1)	4' 3-Lamp T8 VHLO	Electronic	3	32	112	15.5
F43ILL/2	F32T8	Fluorescent, (3) 48" T-8 lamps, (2) Instant Start Ballasts, NLO (0.85 < BF < 0.95)	4' 3-Lamp T8	Electronic	3	32	89	15.5
F43ILL/2-H	F32T8	Fluorescent (3) 48" T-8 lamps, (1) 2-lamp and (1) 3-lamp IS Ballast,1 lead capped, HLO (0.95 < BF < 1.1)	4' 3-Lamp T8 HLO	Electronic	3	32	102	15.5
F43ILL/2-R	F32T8	Fluorescent, (3) 48" T-8 lamps, (1) 1-lamp and (1) 2-lamp IS Ballast, RLO (BF < 0.85)	4' 3-Lamp T8 RLO	Electronic	3	32	78	15.5
F43ILU	F32T8	Fluorescent, (3) 48" T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 3-Lamp T8	Electronic	3	32	81	15.5
F43ILU-H	F32T8	Fluorescent, (3) 48", T-8 lamp, Instant Start Ballast, HLO (0.95 < BF < 1.1)	4' 3-Lamp T8 HLO	Electronic	3	32	92	15.5
F43ILU-R	F32T8	Fluorescent, (3) 48" T-8 lamps, Instant Start Ballast, RLO (BF < 0.85)	4' 3-Lamp T8 RLO	Electronic	3	32	72	15.5
F43ILU-V	F32T8	Fluorescent, (3) 48" T-8 lamps, Instant Start Ballast, VHLO (BF > 1.1)	4' 3-Lamp T8 VHLO	Electronic	3	32	108	15.5
F43LE	F32T8	Fluorescent, (3) 48", T-8 lamp	4' 3-Lamp T8	Mag-ES	3	32	110	15.5
F43LL	F32T8	Fluorescent, (3) 48", T-8 lamps, Rapid Start Ballast, NLO (0.85 < BF < 0.95)	4' 3-Lamp T8	Electronic	3	32	93	15.5
F43LL-H	F32T8	Fluorescent, (3) 48", T-8 lamp, Rapid Start Ballast, HLO (.95 < BF < 1.1)	4' 3-Lamp T8 HLO	Electronic	3	32	98	15.5
F43LL-R	F32T8	Fluorescent, (3) 48", T-8 lamp, Rapid Start Ballast, RLO (BF < 0.85)	4' 3-Lamp T8 RLO	Electronic	3	32	76	15.5
F43LL/2	F32T8	Fluorescent, (3) 48", T-8 lamps, (1) 1-lamp and (1) 2-lamp RS Ballast, NLO (0.85 < BF < 0.95)	4' 3-Lamp T8	Electronic	3	32	92	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F44GLL	F32T8	Fluorescent (4) 48" T-8 lamps, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	4' 4-Lamp T8	PRS Elec.	4	32	115	15.5
F44GLL-R	F32T8	Fluorescent (4) 48" T-8 lamps, Prog. Start or PRS Ballast, RLO (BF < 0.85)	4' 4-Lamp T8 RLO	PRS Elec.	4	32	92	15.5
F44GLL-V	F32T8	Fluorescent, (4) 48" T-8 lamps, Prog. Start or PRS Ballast, VHLO (BF > 1.1)	4' 4-Lamp T8 VHLO	PRS Elec.	4	32	144	15.5
F44ILL	F32T8	Fluorescent, (4) 48", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 4-Lamp T8	Electronic	4	32	112	15.5
F44ILL-R	F32T8	Fluorescent, (4) 48", T-8 lamps, Instant Start Ballast, RLO (BF < 0.85)	4' 4-Lamp T8 RLO	Electronic	4	32	98	15.5
F44ILL-V	F32T8	Fluorescent, (4) 48", T-8 lamps, Instant Start Ballast, VHLO (BF > 1.1)	4' 4-Lamp T8 VHLO	Electronic	4	32	151	15.5
F44ILL/2	F32T8	Fluorescent, (4) 48", T-8 lamps, (2) 2-lamp IS Ballasts, NLO (0.85 < BF < 0.95)	4' 4-Lamp T8	Electronic	4	32	116	15.5
F44ILL/2-H	F32T8	Fluorescent, (4) 48", T-8 lamps, (2) 3-lamp IS Ballasts, 1 lead capped, HLO (.95 < BF < 1.1)	4' 4-Lamp T8 HLO	Electronic	4	32	132	15.5
F44ILL/2-R	F32T8	Fluorescent, (4) 48", T-8 lamps, (2) 2-lamp IS Ballasts, RLO (BF < 0.85)	4' 4-Lamp T8 RLO	Electronic	4	32	102	15.5
F44ILL/2-V	F32T8	Fluorescent, (4) 48", T-8 lamps, (2) 2-lamp IS Ballasts, VHLO (BF > 1.1)	4' 4-Lamp T8 VHLO	Electronic	4	32	154	15.5
F44ILU	F32T8	Fluorescent, (4) 48", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 4-Lamp T8	Electronic	4	32	107	15.5
F44ILU-H	F32T8	Fluorescent, (4) 48", T-8 lamp, Instant Start Ballast, HLO (0.95 < BF < 1.1)	4' 4-Lamp T8 HLO	Electronic	4	32	121	15.5
F44ILU-R	F32T8	Fluorescent, (4) 48", T-8 lamps, Instant Start Ballast, RLO (BF < 0.85)	4' 4-Lamp T8 RLO	Electronic	4	32	95	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F44ILU-V	F32T8	Fluorescent, (4) 48", T-8 lamps, Instant Start Ballast, VHLO (BF > 1.1)	4' 4-Lamp T8 VHLO	Electronic	4	32	146	15.5
F44LE	F32T8	Fluorescent, (4) 48", T-8 lamps	4' 4-Lamp T8	Mag-ES	4	32	142	15.5
F44LL	F32T8	Fluorescent, (4) 48", T-8 lamps, Rapid Start Ballast, NLO (0.85 < BF < 0.95)	4' 4-Lamp T8	Electronic	4	32	118	15.5
F44LL-R	F32T8	Fluorescent, (4) 48", T-8 lamps, Rapid Start Ballast, RLO (BF < 0.85)	4' 4-Lamp T8 RLO	Electronic	4	32	105	15.5
F44LL/2	F32T8	Fluorescent, (4) 48", T-8 lamps, (2) 2-lamp Rapid Start Ballast, NLO (0.85 < BF < 0.95)	4' 4-Lamp T8	Electronic	4	32	120	15.5
F45ILL/2	F32T8	Fluorescent, (5) 48", T-8 lamps, (1) 3-lamp and (1) 2-lamp IS ballast, NLO (0.85 < BF < 0.95)	4' 5-Lamp T8	Electronic	5	32	143	15.5
F45GLL/2-V	F32T8	Fluorescent, (5) 48", T-8 lamps, (1) 3-lamp and (1) 2-lamp Prog. Start Ballast, VHLO (BF > 1.1)	4' 5-Lamp T8 VHLO	Electronic	5	32	182	15.5
F46GLL/2	F32T8	Fluorescent (6) 48" T-8 lamps, (2) Prog. Start or PRS Ballasts, NLO (0.85 < BF < 0.95)	4' 6-Lamp T8	PRS Elec.	6	32	175	15.5
F46GLL/2-R	F32T8	Fluorescent (6) 48" T-8 lamps, (2) Prog. Start or PRS Ballasts, RLO (BF < 0.85)	4' 6-Lamp T8 RLO	PRS Elec.	6	32	142	15.5
F46GLL/2-V	F32T8	Fluorescent (6) 48" T-8 lamps, (2) Prog. Start or PRS Ballasts, VHLO (BF > 1.1)	4' 6-Lamp T8 VHLO	PRS Elec.	6	32	217	15.5
F46ILL/2	F32T8	Fluorescent, (6) 48", T-8 lamps, (2) IS Ballasts, NLO (0.85 < BF < 0.95)	4' 6-Lamp T8	Electronic	6	32	170	15.5
F46ILL/2-R	F32T8	Fluorescent, (6) 48", T-8 lamps, (2) IS Ballasts, RLO (BF < 0.85)	4' 6-Lamp T8 RLO	Electronic	6	32	151	15.5
F46ILL/2-V	F32T8	Fluorescent (6) 48" T-8 lamps, (2) IS Ballasts, VHLO (BF > 1.1)	4' 6-Lamp T8 VHLO	Electronic	6	32	226	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F46ILU/2	F32T8	Fluorescent (6) 48" T-8 lamps, (2) IS Ballasts, NLO (0.85 < BF < 0.95)	4' 6-Lamp T8	Electronic	6	32	162	15.5
F46ILU/2-R	F32T8	Fluorescent (6) 48" T-8 lamps, (2) IS Ballasts, RLO (BF < 0.85)	4' 6-Lamp T8 RLO	Electronic	6	32	144	15.5
F46ILU/2-V	F32T8	Fluorescent (6) 48" T-8 lamps, (2) IS Ballasts, VHLO (BF > 1.1)	4' 6-Lamp T8 VHLO	Electronic	6	32	218	15.5
F465LL/2	F32T8	Fluorescent, (6) 48", T-8 lamps, (2) Rapid Start Ballasts, NLO (0.85 < BF < 0.95)	4' 6-Lamp T8	Electronic	6	32	182	15.5
F48GLL/2	F32T8	Fluorescent (8) 48" T-8 lamps, (2) Prog. Start or PRS Ballasts, NLO (0.85 < BF < 0.95)	4' 8-Lamp T8	PRS Elec.	8	32	230	15.5
F48GLL/2-R	F32T8	Fluorescent (8) 48" T-8 lamps, (2) Prog. Start or PRS Ballasts, RLO (BF < 0.85)	4' 8-Lamp T8 RLO	PRS Elec.	8	32	184	15.5
F48GLL/2-V	F32T8	Fluorescent (8) 48" T-8 lamps, (2) Prog. Start or PRS Ballasts, VHLO (BF > 1.1)	4' 8-Lamp T8 VHLO	PRS Elec.	8	32	288	15.5
F48ILL/2	F32T8	Fluorescent, (8) 48", T-8 lamps, (2) 4-lamp IS Ballasts, NLO (0.85 < BF < 0.95)	4' 8-Lamp T8	Electronic	8	32	224	15.5
F48ILL/2-R	F32T8	Fluorescent, (8) 48", T-8 lamps, (2) 4-lamp IS Ballasts, RLO (BF < 0.85)	4' 8-Lamp T8 RLO	Electronic	8	32	196	15.5
F48ILU/2	F32T8	Fluorescent, (8) 48", T-8 lamps, (2) 4-lamp IS Ballasts, NLO (0.85 < BF < 0.95)	4' 8-Lamp T8	Electronic	8	32	214	15.5
F48ILU/2-R	F32T8	Fluorescent, (8) 48", T-8 lamps, (2) 4-lamp IS Ballasts, RLO (BF < 0.85)	4' 8-Lamp T8 RLO	Electronic	8	32	190	15.5
F48ILU/2-V	F32T8	Fluorescent, (8) 48", T-8 lamps, (2) 4-lamp IS Ballasts, VHLO (BF > 1.1)	4' 8-Lamp T8 VHLO	Electronic	8	32	292	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F41GNLL	F32T8-25W	Fluorescent (1) 48" T-8 @ 25W lamp, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8 25W	PRS Elec.	1	25	24	15.5
F41GNLL-R	F32T8-25W	Fluorescent (1) 48" T-8 @ 25W lamp, Prog. Start or PRS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 25W RLO	PRS Elec.	1	25	21	15.5
F41INLL	F32T8-25W	Fluorescent, (1) 48", T-8 @ 25W lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8 25W	Electronic	1	25	24	15.5
F41INLU	F32T8-25W	Fluorescent, (1), T-8 @ 25W lamp, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8 25W	Electronic	1	25	23	15.5
F41INLU-R	F32T8-25W	Fluorescent, (1), T-8 @ 25W lamp, Instant Start Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 25W RLO	Electronic	1	25	21	15.5
F41INLU-V	F32T8-25W	Fluorescent, (1), T-8 @ 25W lamp, Instant Start Ballast, VHLO (BF > 1.1)	4' 1-Lamp T8 25W VHLO	Electronic	1	25	32	15.5
F41INLU/T3-R	F32T8-25W	Fluorescent, (1) 48", T-8 @ 25W lamp, Tandem 3-lamp IS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 25W RLO	Electronic	1	25	19	15.5
F41INLU/T4-R	F32T8-25W	Fluorescent, (1) 48", T-8 @ 25W lamp, Tandem 4-lamp IS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 25W RLO	Electronic	1	25	19	15.5
F42GNLL	F32T8-25W	Fluorescent (2) 48" T-8 @ 25W lamps, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8 25W	PRS Elec.	2	25	44	15.5
F42GNLL-R	F32T8-25W	Fluorescent (2) 48" T-8 @ 25W lamps, Prog. Start or PRS Ballast, RLO (BF< 0.85)	4' 2-Lamp T8 25W RLO	PRS Elec.	2	25	38	15.5
F42INLL	F32T8-25W	Fluorescent, (2) 48", T-8 @ 25W lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8 25W	Electronic	2	25	46	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F42INLL-V	F32T8-25W	Fluorescent, (2) 48" T-8 @ 25W lamps, Instant Start Ballast, VHLO (BF > 1.1)	4' 2-Lamp T8 25W VHLO	Electronic	2	25	65	15.5
F42INLU	F32T8-25W	Fluorescent, (2), T-8 @ 25W lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8 25W	Electronic	2	25	43	15.5
F42INLU-R	F32T8-25W	Fluorescent (2) 48" T8 @ 25W lamps, Instant Start Ballast, RLO (BF< 0.85)	4' 2-Lamp T8 25W RLO	Electronic	2	25	38	15.5
F42INLU-V	F32T8-25W	Fluorescent, (2) 48", T-8 @ 25W lamps, Instant Start Ballast, VHLO (BF > 1.1)	4' 2-Lamp T8 25W VHLO	Electronic	2	25	60	15.5
F42INLU/T 4-R	F32T8-25W	Fluorescent, (2) 48", T-8 @ 25W lamps, Tandem 4-lamp IS Ballast, RLO (BF< 0.85)	4' 2-Lamp T8 25W RLO	Electronic	2	25	38	15.5
F43GNLL	F32T8-25W	Fluorescent (3) 48" T-8 @ 25W lamps, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	4' 3-Lamp T8 25W	PRS Elec.	3	25	66	15.5
F43GNLL-R	F32T8-25W	Fluorescent, (3) 48" T-8 @ 25W lamps, Prog. Start or PRS Ballast, RLO (BF < 0.85)	4' 3-Lamp T8 25W RLO	PRS Elec.	3	25	56	15.5
F43INLL	F32T8-25W	Fluorescent, (3) 48" T-8 @ 25W lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 3-Lamp T8 25W	Electronic	3	25	66	15.5
F43INLL-V	F32T8-25W	Fluorescent, (3) 48" T-8 @ 25W lamps, Instant Start Ballast, VHLO (BF > 1.1)	4' 3-Lamp T8 25W VHLO	Electronic	3	25	95	15.5
F43INLU	F32T8-25W	Fluorescent, (3) 48" T-8 lamps @ 25W, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 3-Lamp T8 25W	Electronic	3	25	64	15.5
F43INLU-R	F32T8-25W	Fluorescent, (3) 48" T-8 @ 25W lamps, Instant Start Ballast, RLO (BF < 0.85)	4' 3-Lamp T8 25W RLO	Electronic	3	25	57	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F43INLU-V	F32T8-25W	Fluorescent, (3) 48" T-8 @ 25W lamps, Instant Start Ballast, VHLO (BF > 1.1)	4' 3-Lamp T8 25W VHLO	Electronic	3	25	93	15.5
F44GNLL	F32T8-25W	Fluorescent (4) 48" T-8 @ 25W lamps, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	4' 4-Lamp T8 25W	PRS Elec.	4	25	85	15.5
F44GNLL-R	F32T8-25W	Fluorescent (4) 48" T-8 @ 25W lamps, Prog. Start or PRS Ballast, RLO (BF < 0.85)	4' 4-Lamp T8 25W RLO	PRS Elec.	4	25	73	15.5
F44INLL	F32T8-25W	Fluorescent, (4) 48", T-8 @ 25W lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 4-Lamp T8 25W	Electronic	4	25	86	15.5
F44INLU	F32T8-25W	Fluorescent, (4) 48", T-8 @ 25W lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 4-Lamp T8 25W	Electronic	4	25	85	15.5
F44INLU-R	F32T8-25W	Fluorescent, (4) 48" T-8 @ 25W lamps, Instant Start Ballast, RLO (BF < 0.85)	4' 4-Lamp T8 25W RLO	Electronic	4	25	75	15.5
F44INLU-V	F32T8-25W	Fluorescent, (4) 48" T-8 @ 25W lamps, Instant Start Ballast, VHLO (BF > 1.1)	4' 4-Lamp T8 25W VHLO	Electronic	4	25	122	15.5
F46INLU/2-R	F32T8-25W	Fluorescent (6) 48" T-8 @ 25W lamps, (2) IS Ballasts, RLO (BF < 0.85)	4' 6-Lamp T8 25W RLO	Electronic	6	25	114	15.5
F46INLU/2-V	F32T8-25W	Fluorescent (6) 48" T-8 @ 25W lamps, (2) IS Ballasts, VHLO (BF > 1.1)	4' 6-Lamp T8 25W VHLO	Electronic	6	25	184	15.5
F41GRLL	F32T8-28W	Fluorescent (1) 48" T-8 @ 28W lamp, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8 28W	PRS Elec.	1	28	26	15.5
F41GRLL-R	F32T8-28W	Fluorescent (1) 48" T-8 @ 28W lamp, Prog. Start or PRS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 28W RLO	PRS Elec.	1	28	22	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F41IRLL	F32T8-28W	Fluorescent, (1) 48" T-8 @ 28W lamp, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8 28W	Electronic	1	28	27	15.5
F41IRLL-V	F32T8-28W	Fluorescent, (1) 48" T-8 @ 28W lamp, Instant Start Ballast, VHLO (BF > 1.1)	4' 1-Lamp T8 28W VHLO	Electronic	1	28	35	15.5
F41IRLU	F32T8-28W	Fluorescent, (1), T-8 @ 28W lamp, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8 28W	Electronic	1	28	25	15.5
F41IRLU-R	F32T8-28W	Fluorescent, (1), T-8 @ 28W lamp, Instant Start Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 28W RLO	Electronic	1	28	22	15.5
F41IRLU-V	F32T8-28W	Fluorescent, (1), T-8 @ 28W lamp, Instant Start Ballast, VHLO (BF > 1.1)	4' 1-Lamp T8 28W VHLO	Electronic	1	28	33	15.5
F41IRLU/T3-R	F32T8-28W	Fluorescent, (1) 48", T-8 @ 28W lamp, Tandem 3-lamp IS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 28W RLO	Electronic	1	28	21	15.5
F41IRLU/T4-R	F32T8-28W	Fluorescent, (1) 48", T-8 @ 28W lamp, Tandem 4-lamp IS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 28W RLO	Electronic	1	28	21	15.5
F42GRLL	F32T8-28W	Fluorescent (2) 48" T-8 @ 28W lamps, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8 28W	PRS Elec.	2	28	49	15.5
F42GRLL-R	F32T8-28W	Fluorescent (2) 48" T-8 @ 28W lamps, Prog. Start or PRS Ballast, RLO (BF< 0.85)	4' 2-Lamp T8 28W RLO	PRS Elec.	2	28	40	15.5
F42IRLL	F32T8-28W	Fluorescent, (2) 48", T-8 @ 28W lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8 28W NLO	Electronic	2	28	52	15.5
F42IRLL-V	F32T8-28W	Fluorescent, (2) 48" T-8 @ 28W lamps, Instant Start Ballast, VHLO (BF > 1.1)	4' 2-Lamp T8 28W VHLO	Electronic	2	28	68	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F42IRLU	F32T8-28W	Fluorescent, (2), T-8 @ 28W lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8 28W	Electronic	2	28	48	15.5
F42IRLU-R	F32T8-28W	Fluorescent, (2) 48", T-8 @ 28W lamps, Instant Start Ballast, RLO (BF< 0.85)	4' 2-Lamp T8 28W RLO	Electronic	2	28	43	15.5
F42IRLU-V	F32T8-28W	Fluorescent, (2) 48", T-8 @ 28W lamps, Instant Start Ballast, VHLO (BF > 1.1)	4' 2-Lamp T8 28W VHLO	Electronic	2	28	65	15.5
F42IRLU/T 4-R	F32T8-28W	Fluorescent, (2) 48", T-8 @ 28W lamps, Tandem 4-lamp IS Ballast, RLO (BF< 0.85)	4' 2-Lamp T8 28W RLO	Electronic	2	28	42	15.5
F43GRLL	F32T8-28W	Fluorescent (3) 48" T-8 @ 28W lamps, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	4' 3-Lamp T8 28W	PRS Elec.	3	28	75	15.5
F43GRLL-R	F32T8-28W	Fluorescent, (3) 48" T-8 @ 28W lamps, Prog. Start or PRS Ballast, RLO (BF < 0.85)	4' 3-Lamp T8 28W RLO	PRS Elec.	3	28	62	15.5
F43IRLL	F32T8-28W	Fluorescent, (3) 48" T-8 @ 28W lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 3-Lamp T8 28W	Electronic	3	28	76	15.5
F43IRLL-H	F32T8-28W	Fluorescent, (3) 48" T-8 @ 28W lamps, Instant Start Ballast, HLO (.95 < BF < 1.1)	4' 3-Lamp T8 28W HLO	Electronic	3	28	82	15.5
F43IRLL-V	F32T8-28W	Fluorescent, (3) 48" T-8 @ 28W lamps, Instant Start Ballast, VHLO (BF > 1.1)	4' 3-Lamp T8 28W VHLO	Electronic	3	28	97	15.5
F43IRLU	F32T8-28W	Fluorescent, (3) 48" T-8 lamps @ 28W, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 3-Lamp T8 28W	Electronic	3	28	72	15.5
F43IRLU-R	F32T8-28W	Fluorescent, (3) 48" T-8 @ 28W lamps, Instant Start Ballast, RLO (BF < 0.85)	4' 3-Lamp T8 28W RLO	Electronic	3	28	63	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F43IRLU-V	F32T8-28W	Fluorescent, (3) 48" T-8 @ 28W lamps, Instant Start Ballast, VHLO (BF > 1.1)	4' 3-Lamp T8 28W VHLO	Electronic	3	28	96	15.5
F44GRLL	F32T8-28W	Fluorescent (4) 48" T-8 @ 28W lamps, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	4' 4-Lamp T8 28W	PRS Elec.	4	28	99	15.5
F44GRLL-R	F32T8-28W	Fluorescent (4) 48" T-8 @ 28W lamps, Prog. Start or PRS Ballast, RLO (BF < 0.85)	4' 4-Lamp T8 28W RLO	PRS Elec.	4	28	80	15.5
F44IRLL	F32T8-28W	Fluorescent, (4) 48", T-8 @ 28W lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 4-Lamp T8 28W	Electronic	4	28	99	15.5
F44IRLL-R	F32T8-28W	Fluorescent, (4) 48", T-8 @ 28W lamps, Instant Start Ballast, RLO (BF < 0.85)	4' 4-Lamp T8 28W RLO	Electronic	4	28	85	15.5
F44IRLU	F32T8-28W	Fluorescent, (4) 48", T-8 @ 28W lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 4-Lamp T8 28W	Electronic	4	28	94	15.5
F44IRLU-R	F32T8-28W	Fluorescent, (4) 48" T-8 @ 28W lamps, Instant Start Ballast, RLO (BF < 0.85)	4' 4-Lamp T8 28W RLO	Electronic	4	28	83	15.5
F44IRLU-V	F32T8-28W	Fluorescent, (4) 48" T-8 @ 28W lamps, Instant Start Ballast, VHLO (BF > 1.1)	4' 4-Lamp T8 28W VHLO	Electronic	4	28	131	15.5
F46IRLU/2-R	F32T8-28W	Fluorescent (6) 48" T-8 @ 28W lamps, (2) IS Ballasts, RLO (BF < 0.85)	4' 6-Lamp T8 28W	Electronic	6	28	126	15.5
F46IRLU/2-V	F32T8-28W	Fluorescent (6) 48" T-8 @ 28W lamps, (2) IS Ballasts, VHLO (BF > 1.1)	4' 6-Lamp T8 28W VHLO	Electronic	6	28	194	15.5
F48IRLU/2-V	F32T8-28W	Fluorescent (8) 48" T-8 @ 28W lamps, (2) IS Ballasts, VHLO (BF > 1.1)	4' 6-Lamp T8 28W VHLO	Electronic	8	28	250	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F41GELL	F32T8-30W	Fluorescent (1) 48" T-8 @ 30W lamp, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8 30W	PRS Elec.	1	30	28	15.5
F41GELL-R	F32T8-30W	Fluorescent (1) 48" T-8 @ 30W lamp, Prog. Start or PRS Ballast, RLO (BF < 0.85)	4' 1-Lamp T8 30W RLO	PRS Elec.	1	30	24	15.5
F41IELL	F32T8-30W	Fluorescent (1) 48" T-8 @ 30W lamp, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8 30W	Electronic	1	30	29	15.5
F41IELL-H	F32T8-30W	Fluorescent (1) 48" T-8 @ 30W lamp, Instant Start Ballast, HLO (0.95 < BF < 1.1)	4' 1-Lamp T8 30W HLO	Electronic	1	30	34	15.5
F41IELL-R	F32T8-30W	Fluorescent (1) 48" T-8 @ 30W lamp, Instant Start Ballast, RLO (BF < 0.85)	4' 1-Lamp T8 30W RLO	Electronic	1	30	26	15.5
F41IELL/T2	F32T8-30W	Fluorescent (1) 48" T-8 @ 30W lamp, Tandem 2-lamp IS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8 30W	Electronic	1	30	28	15.5
F41IELL/T3	F32T8-30W	Fluorescent (1) 48" T-8 @ 30W lamp, Tandem 3-lamp IS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8 30W	Electronic	1	30	27	15.5
F41IELL/T4	F32T8-30W	Fluorescent (1) 48" T-8 @ 30W lamp, Tandem 4-lamp IS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8 30W	Electronic	1	30	27	15.5
F41IELU	F32T8-30W	Fluorescent, (1) 48", T-8 @ 30W lamp, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8 30W	Electronic	1	30	27	15.5
F41IELU-H	F32T8-30W	Fluorescent (1) 48" T-8 @ 30W lamp, Instant Start Ballast, HLO (0.95 < BF < 1.1)	4' 1-Lamp T8 30W HLO	Electronic	1	30	32	15.5
F41IELU-R	F32T8-30W	Fluorescent (1) 48" T-8 @ 30W lamp, Instant Start Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 30W RLO	Electronic	1	30	24	15.5

Fixture Code	*LAMP CODE*	*DESCRIPTION*	*Layman Term*	*BALLAST*	*LAMP / FIXT*	*W / LAMP*	*W / FIXT*	*EUL*
F41IELU/T 2	F32T8-30W	Fluorescent (1) 48" T-8 @ 30W lamp, Tandem 2-lamp IS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8 30W	Electronic	1	30	26	15.5
F41IELU/T 2-R	F32T8-30W	Fluorescent (1) 48" T-8 @ 30W lamp, Tandem 2-lamp IS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 30W RLO	Electronic	1	30	23	15.5
F41IELU/T 3	F32T8-30W	Fluorescent (1) 48" T-8 @ 30W lamp, Tandem 3-lamp IS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8 30W	Electronic	1	30	26	15.5
F41IELU/T 3-R	F32T8-30W	Fluorescent (1) 48" T-8 @ 30W lamp, Tandem 3-lamp IS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 30W RLO	Electronic	1	30	23	15.5
F41IELU/T 4	F32T8-30W	Fluorescent (1) 48" T-8 @ 30W lamp, Tandem 4-lamp IS Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8 30W	Electronic	1	30	25	15.5
F41IELU/T 4-R	F32T8-30W	Fluorescent (1) 48" T-8 @ 30W lamp, Tandem 4-lamp IS Ballast, RLO (BF< 0.85)	4' 1-Lamp T8 30W RLO	Electronic	1	30	22	15.5
F42GELL	F32T8-30W	Fluorescent (2) 48" T-8 @ 30W lamps, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8 30W	PRS Elec.	2	30	56	15.5
F42GELL-R	F32T8-30W	Fluorescent (2) 48" T-8 @ 30W lamps, Prog. Start or PRS Ballast, RLO (BF < 0.85)	4' 2-Lamp T8 30W RLO	PRS Elec.	2	30	43	15.5
F42IELL	F32T8-30W	Fluorescent (2) 48" T-8 @ 30W lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8 30W	Electronic	2	30	55	15.5
F42IELL-H	F32T8-30W	Fluorescent (2) 48" T-8 @ 30W lamps, Instant Start Ballast, HLO (0.95 < BF < 1.1)	4' 2-Lamp T8 30W HLO	Electronic	2	30	62	15.5
F42IELL-R	F32T8-30W	Fluorescent (2) 48" T-8 @ 30W lamps, Instant Start Ballast, RLO (BF< 0.85)	4' 2-Lamp T8 30W RLO	Electronic	2	30	49	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F42IELL/T 4	F32T8-30W	Fluorescent (4) 48" T-8 @ 30W lamps, Tandem 4-lamp IS Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8 30W	Electronic	2	30	53	15.5
F42IELL/T 4-R	F32T8-30W	Fluorescent (4) 48" T-8 @ 30W lamps, Tandem 4-lamp IS Ballast, RLO (BF< 0.85)	4' 2-Lamp T8 30W RLO	Electronic	2	30	46	15.5
F42IELU	F32T8-30W	Fluorescent (2) 48" T-8 @ 30W lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8 30W	Electronic	2	30	52	15.5
F42IELU-R	F32T8-30W	Fluorescent (2) 48" T-8 @ 30W lamps, Instant Start, RLO (BF< 0.85)	4' 2-Lamp T8 30W RLO	Electronic	2	30	45	15.5
F42IELU-V	F32T8-30W	Fluorescent (2) 48" T-8 @ 30W lamps, Instant Start, VHLO (BF > 1.1)	4' 2-Lamp T8 30W HLO	Electronic	2	30	70	15.5
F42IELU/T 4	F32T8-30W	Fluorescent (2) 48" T-8 @ 30W lamps, Tandem 4-lamp IS Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8 30W	Electronic	2	30	51	15.5
F42IELU/T 4-R	F32T8-30W	Fluorescent (2) 48" T-8 @ 30W lamps, Tandem 4-lamp IS Ballast, RLO (BF< 0.85)	4' 2-Lamp T8 30W RLO	Electronic	2	30	45	15.5
F43GELL	F32T8-30W	Fluorescent (3) 48" T-8 @ 30W lamps, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	4' 3-Lamp T8 30W	PRS Elec.	3	30	83	15.5
F43GELL-R	F32T8-30W	Fluorescent (3) 48" T-8 @ 30W lamps, Prog. Start or PRS Ballast, RLO (BF < 0.85)	4' 3-Lamp T8 30W RLO	PRS Elec.	3	30	67	15.5
F43IELL	F32T8-30W	Fluorescent (3) 48" T-8 @ 30 W lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 3-Lamp T8 30W	Electronic	3	30	81	15.5
F43IELL-H	F32T8-30W	Fluorescent (3) 48" T-8 @ 30 W lamps, Instant Start Ballast, HLO (0.95 < BF < 1.1)	4' 3-Lamp T8 30W HLO	Electronic	3	30	86	15.5
F43IELL-R	F32T8-30W	Fluorescent (3) 48" T-8 @ 30 W lamps, Instant Start Ballast, RLO (BF < 0.85)	4' 3-Lamp T8 30W RLO	Electronic	3	30	71	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F43IELL/2	F32T8-30W	Fluorescent (3) 48" T-8 @ 30 W lamps, (1) 1-lamp and (1) 2-lamp IS Ballast, NLO (0.85 < BF < 0.95)	4' 3-Lamp T8 30W	Electronic	3	30	84	15.5
F43IELL/2-H	F32T8-30W	Fluorescent (3) 48" T-8 @ 30 W lamps, (1) 2-lamp, (1) 3-lamp IS Ballast, 1 lead capped, HLO (0.95 < BF < 1.1)	4' 3-Lamp T8 30W HLO	Electronic	3	30	96	15.5
F43IELL/2-R	F32T8-30W	Fluorescent (3) 48" T-8 @ 30 W lamps, (1) 1-lamp and (1) 2-lamp IS Ballast, RLO (BF < 0.85)	4' 3-Lamp T8 30W RLO	Electronic	3	30	75	15.5
F43IELU	F32T8-30W	Fluorescent (3) 48" T-8 @ 30W lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 3-Lamp T8 30W	Electronic	3	30	77	15.5
F43IELU-R	F32T8-30W	Fluorescent (3) 48" T-8 @ 30W lamps, Instant Start Ballast, RLO (BF < 0.85)	4' 3-Lamp T8 30W RLO	Electronic	3	30	68	15.5
F43IELU-V	F32T8-30W	Fluorescent (3) 48" T-8 @ 30W lamps, Instant Start Ballast, VHLO (BF > 1.1)	4' 3-Lamp T8 30W VHLO	Electronic	3	30	104	15.5
F44GELL	F32T8-30W	Fluorescent (4) 48" T-8 @ 30W lamps, Prog. Start or PRS Ballast, NLO (0.85 < BF < 0.95)	4' 4-Lamp T8 30W	PRS Elec.	4	30	109	15.5
F44GELL-R	F32T8-30W	Fluorescent (4) 48" T-8 @ 30W lamps, Prog. Start or PRS Ballast, RLO (BF < 0.85)	4' 4-Lamp T8 30W RLO	PRS Elec.	4	30	86	15.5
F44IELL	F32T8-30W	Fluorescent (4) 48" T-8 @ 30W lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 4-Lamp T8 30W	Electronic	4	30	106	15.5
F44IELL-R	F32T8-30W	Fluorescent (4) 48" T-8 @ 30W lamps, Instant Start Ballast, RLO (BF < 0.85)	4' 4-Lamp T8 30W RLO	Electronic	4	30	92	15.5
F44IELL/2	F32T8-30W	Fluorescent (4) 48" T-8 @ 30W lamps, (2) 2-lamp IS Ballasts, NLO (0.85 < BF < 0.95)	4' 4-Lamp T8 30W	Electronic	4	30	110	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F44IELL/2-H	F32T8-30W	Fluorescent (4) 48" T-8 @ 30W lamps, (2) 3-lamp IS Ballasts, 1 lead capped, HLO (.95 < BF < 1.1)	4' 4-Lamp T8 30W HLO	Electronic	4	30	124	15.5
F44IELL/2-R	F32T8-30W	Fluorescent (4) 48" T-8 @ 30W lamps, (2) 2-lamp IS Ballasts, RLO (BF< 0.85)	4' 4-Lamp T8 30W RLO	Electronic	4	30	98	15.5
F44IELU	F32T8-30W	Fluorescent (4) 48" T-8 @ 30W lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 4-Lamp T8 30W	Electronic	4	30	101	15.5
F44IELU-R	F32T8-30W	Fluorescent (4) 48" T-8 @ 30W lamps, Instant Start Ballast, RLO (BF < 0.85)	4' 4-Lamp T8 30W RLO	Electronic	4	30	89	15.5
F46IELU/2	F32T8-30W	Fluorescent (6) 48" T-8 @ 30W lamps, (2) IS Ballasts, NLO (0.85 < BF < 0.95)	4' 6-Lamp T8 30W	Electronic	6	30	154	15.5
F46IELU/2-R	F32T8-30W	Fluorescent (6) 48" T-8 @ 30W lamps, (2) IS Ballasts, RLO (BF < 0.85)	4' 6-Lamp T8 30W RLO	Electronic	6	30	135	15.5
F51ILL	F40T8	Fluorescent, (1) 60", T-8 lamp, Instant Start Ballast, NLO (0.85 < BF < 0.95)	5' 1-Lamp T8	Electronic	1	40	36	15.5
F51ILL-R	F40T8	Fluorescent, (1) 60", T-8 lamp, Instant Start Ballast, RLO (BF < 0.85)	5' 1-Lamp T8 RLO	Electronic	1	40	43	15.5
F51ILL/T2	F40T8	Fluorescent, (1) 60", T-8 lamp, Tandem 2-lamp IS Ballast, NLO (0.85 < BF < 0.95)	5' 1-Lamp T8	Electronic	1	40	36	15.5
F51ILL/T3	F40T8	Fluorescent, (1) 60", T-8 lamp, Tandem 3-lamp IS Ballast, NLO (0.85 < BF < 0.95)	5' 1-Lamp T8	Electronic	1	40	35	15.5
F51ILL/T4	F40T8	Fluorescent, (1) 60", T-8 lamp, Tandem 4-lamp IS Ballast, NLO (0.85 < BF < 0.95)	5' 1-Lamp T8	Electronic	1	40	34	15.5
F52ILL	F40T8	Fluorescent, (2) 60", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF <	5' 2-Lamp T8	Electronic	2	40	72	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
		0.95)						
F52ILL-H	F40T8	Fluorescent, (2) 60", T-8 lamps, Instant Start Ballast, HILO (.95 < BF < 1.1)	5' 2-Lamp T8 HLO	Electronic	2	40	80	15.5
F52ILL-R	F40T8	Fluorescent, (2) 60", T-8 lamps, Instant Start Ballast, RLO (BF < 0.85)	5' 2-Lamp T8 RLO	Electronic	2	40	73	15.5
F52ILL/T4	F40T8	Fluorescent, (2) 60", T-8 lamps, Tandem 4-lamp IS Ballast, NLO (0.85 < BF < 0.95)	5' 2-Lamp T8	Electronic	2	40	67	15.5
F53ILL	F40T8	Fluorescent, (3) 60", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	5' 3-Lamp T8	Electronic	3	40	106	15.5
F53ILL-H	F40T8	Fluorescent, (3) 60", T-8 lamps, Instant Start Ballast, HILO (.95 < BF < 1.1)	5' 3-Lamp T8 HLO	Electronic	3	40	108	15.5
F54ILL	F40T8	Fluorescent, (4) 60", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	5' 4-Lamp T8	Electronic	4	40	134	15.5
F54ILL-H	F40T8	Fluorescent, (4) 60", T-8 lamps, Instant Start Ballast, HLO (.95 < BF < 1.1)	5' 4-Lamp T8 HLO	Electronic	4	40	126	15.5
F41LHL	F48T8/HO	Fluorescent, (1) 48", T-8 HO lamps, (1) Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 1-Lamp T8 44W HO	Electronic	1	44	59	15.5
F42LHL	F48T8/HO	Fluorescent, (2) 48", T-8 HO lamps, (1) Instant Start Ballast, NLO (0.85 < BF < 0.95)	4' 2-Lamp T8 44W HO	Electronic	2	44	98	15.5
F43LHL	F48T8/HO	Fluorescent, (3) 48", T-8 HO lamps, (2) Instant Start Ballasts, NLO (0.85 < BF < 0.95)	4' 3-Lamp T8 44W HO	Electronic	3	44	141	15.5
F44LHL	F48T8/HO	Fluorescent, (4) 48", T-8 HO lamps, (2) Instant Start Ballasts, NLO (0.85 < BF < 0.95)	4' 4-Lamp T8 44W HO	Electronic	4	44	168	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F81ILL	F96T8	Fluorescent, (1) 96", T-8 lamp, Instant Start Ballast, NLO (0.85 < BF < 0.95)	8' 1-Lamp T8	Electronic	1	59	69	15.5
F81ILL-H	F96T8	Fluorescent, (1) 96", T-8 lamp, Instant Start Ballast, HILO (.95 < BF < 1.1)	8' 1-Lamp T8 HLO	Electronic	1	59	70	15.5
F81ILL-R	F96T8	Fluorescent, (1) 96", T-8 lamp, Instant Start Ballast, RLO (BF < 0.85)	8' 1-Lamp T8 RLO	Electronic	1	59	67	15.5
F81ILL-V	F96T8	Fluorescent, (1) 96", T-8 lamp, Instant Start Ballast, VHLO (BF > 1.1)	8' 1-Lamp T8 VHLO	Electronic	1	59	72	15.5
F81ILL/T2	F96T8	Fluorescent, (1) 96", T-8 lamp, Tandem 2-lamp IS Ballast, NLO (0.85 < BF < 0.95)	8' 1-Lamp T8	Electronic	1	59	55	15.5
F81ILL/T2-R	F96T8	Fluorescent, (1) 96", T-8 lamp, Tandem 2-lamp IS Ballast, RLO (BF < 0.85)	8' 1-Lamp T8 RLO	Electronic	1	59	50	15.5
F81ILU	F96T8	Fluorescent, (1) 96" T-8 lamp, Instant Start Ballast, NLO (0.85 < BF < 0.95)	8' 1-Lamp T8	Electronic	1	59	67	15.5
F82ILL	F96T8	Fluorescent, (2) 96", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	8' 2-Lamp T8	Electronic	2	59	110	15.5
F82ILL-R	F96T8	Fluorescent, (2) 96", T-8 lamps, Instant Start Ballast, RLO (BF < 0.85)	8' 2-Lamp T8 RLO	Electronic	2	59	100	15.5
F82ILL-V	F96T8	Fluorescent, (2) 96", T-8 lamps, Instant Start Ballast, VHLO (BF > 1.1)	8' 2-Lamp T8 VHLO	Electronic	2	59	149	15.5
F82ILU	F96T8	Fluorescent, (2) 96" T-8 ES lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	8' 2-Lamp T8	Electronic	2	59	107	15.5
F83ILL	F96T8	Fluorescent, (3) 96", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	8' 3-Lamp T8	Electronic	3	59	179	15.5
F84ILL	F96T8	Fluorescent, (4) 96", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF <	8' 4-Lamp T8	Electronic	4	59	219	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
		0.95)						
F84ILL/2-V	F96T8	Fluorescent, (4) 96", T-8 lamps, (2) Instant Start Ballasts, VHLO (BF > 1.1)	8' 4-Lamp T8 VHLO	Electronic	4	59	298	15.5
F86ILL	F96T8	Fluorescent, (6) 96", T-8 lamps, (2) 3-lamp IS Ballasts, NLO (0.85 < BF < 0.95)	8' 6-Lamp T8	Electronic	6	59	330	15.5
F81LHL/T2	F96T8/HO	Fluorescent, (1) 96", T-8 HO lamp, Tandem 2-lamp Ballast	8' 1-Lamp T8 86W HO	Electronic	1	86	80	15.5
F82LHL	F96T8/HO	Fluorescent, (2) 96", T-8 HO lamps	8' 2-Lamp T8 86W HO	Electronic	2	86	160	15.5
F84LHL	F96T8/HO	Fluorescent, (4) 96", T-8 HO lamps	8' 4-Lamp T8 86W HO	Electronic	4	86	320	15.5
F81IERU	F96T8-RW	Fluorescent, (1) 96" T-8 reduced-wattage lamp, Instant Start Ballast, NLO (0.85 < BF < 0.95)	8' 1-Lamp T8 54W	Electronic	1	54	61	15.5
F82IERU	F96T8-RW	Fluorescent, (2) 96" T-8 @ reduced-wattage lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	8' 2-Lamp T8 54W	Electronic	2	54	93	15.5
FT12		T12 and Other Linear Fluorescent Systems						
F1.51SS	F15T12	Fluorescent, (1) 18" T12 lamp	1.5' 1-Lamp T12 15W	Mag-STD	1	15	19	8.5
F1.52SS	F15T12	Fluorescent, (2) 18", T12 lamps	1.5' 2-Lamp T12 15W	Mag-STD	2	15	36	8.5
F21SS	F20T12	Fluorescent, (1) 24", STD lamp	2' 1-Lamp T12 20W	Mag-STD	1	20	25	8.5
F22SS	F20T12	Fluorescent, (2) 24", STD lamps	2' 2-Lamp T12 20W	Mag-STD	2	20	50	8.5
F23SS	F20T12	Fluorescent, (3) 24", STD lamps	2' 3-Lamp T12 20W	Mag-STD	3	20	71	8.5
F24SS	F20T12	Fluorescent, (4) 24", STD lamps	2' 4-Lamp T12 20W	Mag-STD	4	20	100	8.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F26SS/2	F20T12	Fluorescent, (6) 24", STD lamps, (2) ballasts	2' 6-Lamp T12 20W	Mag-STD	6	20	146	8.5
F21HS	F24T12/HO	Fluorescent, (1) 24", HO lamp	2' 1-Lamp T12HO	Mag-STD	1	35	62	8.5
F22HS	F24T12/HO	Fluorescent, (2) 24", HO lamps	2' 2-Lamp T12HO	Mag-STD	2	35	90	8.5
F32EL/T4	F25T12	Fluorescent, (2) 36" ES lamps, Tandem 4-lamp ballast, NLO (0.85 < BF < 0.95)	3' 2-Lamp T12ES	Electronic	2	25	50	15.5
F41IAL	F25T12	Fluorescent, (1) 48", F25T12 lamp, Instant Start Ballast	4' 1-Lamp T12 25W	Electronic	1	25	25	15.5
F41IAL/T2-R	F25T12	Fluorescent, (1) 48", F25T12 lamp, Tandem 2-Lamp IS ballast, RLO (BF < 0.85)	4' 1-Lamp T12 25W RLO	Electronic	1	25	19	15.5
F41IAL/T3-R	F25T12	Fluorescent, (1) 48", F25T12 lamp, Tandem 3-Lamp IS ballast, RLO (BF < 0.85)	4' 1-Lamp T12 25W RLO	Electronic	1	25	20	15.5
F41IAL/T4-R	F25T12	Fluorescent, (1) 48", F25T12 lamp, Tandem 4-Lamp IS ballast, RLO (BF < 0.85)	4' 1-Lamp T12 25W RLO	Electronic	1	25	20	15.5
F42IAL-R	F25T12	Fluorescent, (2) 48", F25T12 lamps, Instant Start Ballast, RLO (BF < 0.85)	4' 2-Lamp T12 25W RLO	Electronic	2	25	39	15.5
F42IAL/T4-R	F25T12	Fluorescent, (2) 48", F25T12 lamps, Tandem 4-lamp IS Ballast, RLO (BF < 0.85)	4' 2-Lamp T12 25W RLO	Electronic	2	25	40	15.5
F43IAL-R	F25T12	Fluorescent, (3) 48", F25T12 lamps, Instant Start Ballast, RLO (BF < 0.85)	4' 3-Lamp T12 25W RLO	Electronic	3	25	60	15.5
F44IAL-R	F25T12	Fluorescent, (4) 48", F25T12 lamps, Instant Start Ballast, RLO (BF < 0.85)	4' 4-Lamp T12 25W RLO	Electronic	4	25	80	15.5
F31SE/T2	F30T12	Fluorescent, (1) 36", STD lamp, Tandem 2-lamp ballast	3' 1-Lamp T12	Mag-ES	1	30	37	8.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F31SL	F30T12	Fluorescent, (1) 36", STD lamp	3' 1-Lamp T12	Electronic	1	30	31	15.5
F31SS	F30T12	Fluorescent, (1) 36", STD lamp	3' 1-Lamp T12	Mag-STD	1	30	46	8.5
F31SS/T2	F30T12	Fluorescent, (1) 36", STD lamp, Tandem 2-lamp ballast	3' 1-Lamp T12	Mag-STD	1	30	41	8.5
F32SE	F30T12	Fluorescent, (2) 36", STD lamps	3' 2-Lamp T12	Mag-ES	2	30	74	8.5
F32SL	F30T12	Fluorescent, (2) 36", STD lamps	3' 2-Lamp T12	Electronic	2	30	58	15.5
F32SS	F30T12	Fluorescent, (2) 36", STD lamps	3' 2-Lamp T12	Mag-STD	2	30	75	8.5
F33SE	F30T12	Fluorescent, (3) 36", STD lamps, (1) STD ballast and (1) ES ballast	3' 3-Lamp T12	Mag-ES	3	30	120	8.5
F33SS	F30T12	Fluorescent, (3) 36", STD lamps	3' 3-Lamp T12	Mag-STD	3	30	127	8.5
F34SE	F30T12	Fluorescent, (4) 36", STD lamps	3' 4-Lamp T12	Mag-ES	4	30	148	8.5
F34SL	F30T12	Fluorescent, (4) 36", STD lamps	3' 4-Lamp T12	Electronic	4	30	116	15.5
F34SS	F30T12	Fluorescent, (4) 36", STD lamps	3' 4-Lamp T12	Mag-STD	4	30	150	8.5
F36SE	F30T12	Fluorescent, (6) 36", STD lamps	3' 6-Lamp T12ES	Mag-ES	6	30	213	8.5
F36SS	F30T12	Fluorescent, (6) 36", STD lamps	3' 6-Lamp T12	Mag-STD	6	30	225	8.5
F31EE/T2	F30T12/ES	Fluorescent, (1) 36", ES lamp, Tandem 2-lamp ballast	3' 1-Lamp T12ES	Mag-ES	1	25	33	8.5
F31EL	F30T12/ES	Fluorescent, (1) 36", ES lamp	3' 1-Lamp T12ES	Electronic	1	25	26	15.5
F31ES	F30T12/ES	Fluorescent, (1) 36", ES lamp	3' 1-Lamp T12ES	Mag-STD	1	25	42	8.5
F31ES/T2	F30T12/ES	Fluorescent, (1) 36", ES lamp, Tandem 2-lamp ballast	3' 1-Lamp T12ES	Mag-STD	1	25	33	8.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F32EE	F30T12/ES	Fluorescent, (2) 36", ES lamps	3' 1-Lamp T12ES	Mag-ES	2	25	66	8.5
F32EL	F30T12/ES	Fluorescent, (2) 36", ES lamps	3' 1-Lamp T12ES	Electronic	2	25	50	15.5
F32ES	F30T12/ES	Fluorescent, (2) 36", ES lamps	3' 1-Lamp T12ES	Mag-STD	2	25	73	8.5
F33ES	F30T12/ES	Fluorescent, (3) 36", ES lamps	3' 2-Lamp T12ES	Mag-STD	3	25	115	8.5
F34EE	F30T12/ES	Fluorescent, (4) 36", ES lamps	3' 4-Lamp T12ES	Mag-ES	4	25	132	8.5
F36EE	F30T12/ES	Fluorescent, (6) 36", ES lamps	3' 6-Lamp T12ES	Mag-ES	6	30	198	8.5
F36ES	F30T12/ES	Fluorescent, (6) 36", ES lamps	3' 6-Lamp T12ES	Mag-STD	6	30	219	8.5
F31SHS	F36T12/HO	Fluorescent, (1) 36", HO lamp	3' 1-Lamp T5HO	Mag-STD	1	50	70	8.5
F32SHS	F36T12/HO	Fluorescent, (2) 36", HO, lamps	3' 2-Lamp T12HO	Mag-STD	2	50	114	8.5
F41SIL	F40T12	Fluorescent, (1) 48", STD IS lamp, Electronic ballast	4' 1-Lamp T12	Electronic	1	39	46	15.5
F41SIL/T2	F40T12	Fluorescent, (1) 48", STD IS lamp, Tandem 2-lamp IS ballast	4' 1-Lamp T12	Electronic	1	39	37	15.5
F42SIL	F40T12	Fluorescent, (2) 48", STD IS lamps, Electronic ballast	4' 2-Lamp T12IS	Electronic	2	39	74	15.5
F43SIL	F40T12	Fluorescent, (3) 48", STD IS lamps, Electronic ballast	4' 3-Lamp T12IS	Electronic	3	39	120	15.5
F44SIL	F40T12	Fluorescent, (4) 48", STD IS lamps, Electronic ballast	4' 4-Lamp T12IS	Electronic	4	39	148	15.5
F46SL	F40T12	Fluorescent, (6) 48", STD lamps	4' 4-Lamp T12	Electronic	6	40	186	15.5
F41TS	F40T10	Fluorescent, (1) 48", T-10 lamp	4' 1-Lamp T10	Mag-STD	1	40	51	8.5
F41EE	F40T12/ES	Fluorescent, (1) 48", ES lamp	4' 1-Lamp T12ES	Mag-ES	1	34	43	8.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F41EE/2	F40T12/ES	Fluorescent, (1) 48", ES lamp, 2 ballast	4' 1-Lamp T12ES	Mag-ES	1	34	43	8.5
F41EE/T2	F40T12/ES	Fluorescent, (1) 48", ES lamp, Tandem 2-lamp ballast	4' 1-Lamp T12ES	Mag-ES	1	34	36	8.5
F41EL	F40T12/ES	Fluorescent, (1) 48", T12 ES lamp, Electronic Ballast	4' 1-Lamp T12ES	Electronic	1	34	32	15.5
F42EE	F40T12/ES	Fluorescent, (2) 48", ES lamp	4' 2-Lamp T12ES	Mag-ES	2	34	72	8.5
F42EE/2	F40T12/ES	Fluorescent, (2) 48", ES lamps, (2) 1-lamp ballasts	4' 2-Lamp T12ES	Mag-ES	2	34	86	8.5
F42EE/D2	F40T12/ES	Fluorescent, (2) 48", ES lamps, 2 Ballasts (delamped)	4' 2-Lamp T12ES	Mag-ES	2	34	76	8.5
F42EL	F40T12/ES	Fluorescent, (2) 48", T12 ES lamps, Electronic Ballast	4' 2-Lamp T12ES	Electronic	2	34	60	15.5
F43EE	F40T12/ES	Fluorescent, (3) 48", ES lamps	4' 3-Lamp T12ES	Mag-ES	3	34	115	8.5
F43EE/T2	F40T12/ES	Fluorescent, (3) 48", ES lamps, Tandem 2-lamp ballasts	4' 3-Lamp T12ES	Mag-ES	3	34	108	8.5
F43EL	F40T12/ES	Fluorescent, (3) 48", T12 ES lamps, Electronic Ballast	4' 3-Lamp T12ES	Electronic	3	34	92	15.5
F44EE	F40T12/ES	Fluorescent, (4) 48", ES lamps	4' 3-Lamp T12ES	Mag-ES	4	34	144	8.5
F44EE/D3	F40T12/ES	Fluorescent, (4) 48", ES lamps, 3 Ballasts (delamped)	4' 4-Lamp T12ES	Mag-ES	4	34	148	8.5
F44EE/D4	F40T12/ES	Fluorescent, (4) 48", ES lamps, 4 Ballasts (delamped)	4' 3-Lamp T12ES	Mag-ES	4	34	152	8.5
F44EL	F40T12/ES	Fluorescent, (4) 48", T12 ES lamps, Electronic Ballast	4' 4-Lamp T12ES	Electronic	4	34	120	15.5
F46EE	F40T12/ES	Fluorescent, (6) 48", ES lamps	4' 6-Lamp T12ES	Mag-ES	6	34	216	8.5
F46EL	F40T12/ES	Fluorescent, (6) 48", ES lamps	4' 6-Lamp T12ES	Electronic	6	34	180	15.5
F48EE	F40T12/ES	Fluorescent, (8) 48", ES lamps	4' 8-Lamp T12ES	Mag-ES	8	34	288	8.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F42EHS	F42T12/HO/ ES	Fluorescent, (2) 42", HO lamps (3.5' lamp)	4' 2-Lamp T12HO	Mag-STD	2	55	135	8.5
F43EHS	F42T12/HO/ ES	Fluorescent, (3) 42", HO lamps (3.5' lamp)	4' 3-Lamp T12ES HO	Mag-STD	3	55	215	8.5
F41EIS	F48T12/ES	Fluorescent, (1) 48" ES Instant Start lamp. Magnetic ballast	4' 1-Lamp T12ES	Mag-STD	1	40	51	8.5
F42EIS	F48T12/ES	Fluorescent, (2) 48" ES Instant Start lamps. Magnetic ballast	4' 2-Lamp T12ES	Mag-STD	2	40	82	8.5
F43EIS	F48T12/ES	Fluorescent, (3) 48" ES Instant Start lamps. Magnetic ballast	4' 3-Lamp T12ES	Mag-STD	3	40	133	8.5
F44EIS	F48T12/ES	Fluorescent, (4) 48" ES Instant Start lamps. Magnetic ballast	4' 4-Lamp T12IS	Mag-STD	4	40	164	8.5
F41SHS	F48T12/HO	Fluorescent, (1) 48", STD HO lamp	4' 1-Lamp T12HO	Mag-STD	1	60	85	8.5
F42SHS	F48T12/HO	Fluorescent, (2) 48", STD HO lamps	4' 2-Lamp T12HO	Mag-STD	2	60	145	8.5
F43SHS	F48T12/HO	Fluorescent, (3) 48", STD HO lamps	4' 3-Lamp T12HO	Mag-STD	3	60	230	8.5
F44SHS	F48T12/HO	Fluorescent, (4) 48", STD HO lamps	4' 4-Lamp T12HO	Mag-STD	4	60	290	8.5
F41EHS	F48T12/HO/ ES	Fluorescent, (1) 48", ES HO lamp	4' 1-Lamp T12HO	Mag-STD	1	55	80	8.5
F44EHS	F48T12/HO/ ES	Fluorescent, (4) 48", ES HO lamps	4' 3-Lamp T12ES HO	Mag-STD	4	55	270	8.5
F41SVS	F48T12/VHO	Fluorescent, (1) 48", STD VHO lamp	4' 1-Lamp T12VHO	Mag-STD	1	110	140	8.5
F42SVS	F48T12/VHO	Fluorescent, (2) 48", STD VHO lamps	4' 2-Lamp T12VHO	Mag-STD	2	110	252	8.5
F43SVS	F48T12/VHO	Fluorescent, (3) 48", STD VHO lamps	4' 3-Lamp T12VHO	Mag-STD	3	110	377	8.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F44SVS	F48T12/VHO	Fluorescent, (4) 48", STD VHO lamps	4' 4-Lamp T12VHO	Mag-STD	4	110	484	8.5
F44EVS	F48T12/VHO /ES	Fluorescent, (4) 48", VHO ES lamps	4' 4-Lamp T12VHO	Mag-STD	4	100	420	8.5
F51SL	F60T12	Fluorescent, (1) 60", STD lamp	5' 1-Lamp T12	Electronic	1	50	44	15.5
F51SS	F60T12	Fluorescent, (1) 60", STD lamp	5' 1-Lamp T12	Mag-STD	1	50	63	8.5
F52SL	F60T12	Fluorescent, (2) 60", STD lamps	5' 2-Lamp T12	Electronic	2	50	88	15.5
F52SS	F60T12	Fluorescent, (2) 60", STD lamps	5' 2-Lamp T12	Mag-STD	2	50	128	8.5
F51SHE	F60T12/HO	Fluorescent, (1) 60", STD HO lamp	5' 1-Lamp T12HO	Mag-ES	1	75	88	8.5
F51SHL	F60T12/HO	Fluorescent, (1) 60", STD HO lamp	5' 1-Lamp T12HO	Electronic	1	75	69	15.5
F51SHS	F60T12/HO	Fluorescent, (1) 60", STD HO lamp	5' 1-Lamp T12HO	Mag-STD	1	75	92	8.5
F52SHE	F60T12/HO	Fluorescent, (2) 60", STD HO lamps	5' 2-Lamp T12HO	Mag-ES	2	75	176	8.5
F52SHL	F60T12/HO	Fluorescent, (2) 60", STD HO lamps	5' 2-Lamp T12HO	Electronic	2	75	138	15.5
F52SHS	F60T12/HO	Fluorescent, (2) 60", STD HO lamps	5' 2-Lamp T12HO	Mag-STD	2	75	168	8.5
F51SVS	F60T12/VHO	Fluorescent, (1) 60", VHO ES lamp	5' 1-Lamp T12VHO	Mag-STD	1	135	165	8.5
F52SVS	F60T12/VHO	Fluorescent, (2) 60", VHO ES lamps	5' 2-Lamp T12VHO	Mag-STD	2	135	310	8.5
F61ISL	F72T12	Fluorescent, (1) 72", STD lamp, IS electronic ballast	6' 1-Lamp T12	Electronic	1	55	68	15.5
F61SS	F72T12	Fluorescent, (1) 72", STD lamp	6' 1-Lamp T12	Mag-STD	1	55	76	8.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F62ISL	F72T12	Fluorescent, (2) 72", STD lamps, IS electronic ballast	6' 2-Lamp T12IS	Electronic	2	55	108	15.5
F62SE	F72T12	Fluorescent, (2) 72", STD lamps	6' 2-Lamp T12	Mag-ES	2	55	122	8.5
F62SL	F72T12	Fluorescent, (2) 72", STD lamps	6' 2-Lamp T12	Electronic	2	55	108	15.5
F62SS	F72T12	Fluorescent, (2) 72", STD lamps	6' 2-Lamp T12	Mag-STD	2	55	142	8.5
F63ISL	F72T12	Fluorescent, (3) 72", STD lamps, IS electronic ballast	6' 3-Lamp T12IS	Electronic	3	55	176	15.5
F63SS	F72T12	Fluorescent, (3) 72", STD lamps	6' 3-Lamp T12	Mag-STD	3	55	202	8.5
F64ISL	F72T12	Fluorescent, (4) 72", STD lamps, IS electronic ballast	6' 4-Lamp T12IS	Electronic	4	55	216	15.5
F64SE	F72T12	Fluorescent, (4) 72", STD lamps	6' 4-Lamp T12	Mag-ES	4	55	244	8.5
F64SS	F72T12	Fluorescent, (4) 72", STD lamps	6' 4-Lamp T12	Mag-STD	4	56	244	8.5
F61SHS	F72T12/HO	Fluorescent, (1) 72", STD HO lamp	6' 1-Lamp T12HO	Mag-STD	1	85	106	8.5
F62SHE	F72T12/HO	Fluorescent, (2) 72", STD HO lamps	6' 2-Lamp T12HO	Mag-ES	2	85	194	8.5
F62SHL	F72T12/HO	Fluorescent, (2) 72", STD HO lamps	6' 2-Lamp T12HO	Electronic	2	85	167	15.5
F62SHS	F72T12/HO	Fluorescent, (2) 72", STD HO lamps	6' 2-Lamp T12HO	Mag-STD	2	85	200	8.5
F64SHE	F72T12/HO	Fluorescent, (4) 72", HO lamps	6' 4-Lamp T12HO	Mag-ES	4	85	388	8.5
F61SVS	F72T12/VHO	Fluorescent, (1) 72", VHO lamp	6' 1-Lamp T12VHO	Mag-STD	1	160	180	8.5
F62SVS	F72T12/VHO	Fluorescent, (2) 72", VHO lamps	6' 2-Lamp T12VHO	Mag-STD	2	160	330	8.5
F71HS	F84T12/HO	Fluorescent, (1) 84", HO lamp	7' 1-Lamp T12HO	Mag-ES	1	100	104	8.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F72HS	F84T12/HO	Fluorescent, (2) 84", HO lamp	7' 2-Lamp T12HO	Mag-ES	2	100	198	8.5
F81SL	F96T12	Fluorescent, (1) 96", STD lamp	8' 1-Lamp T12	Electronic	1	75	69	15.5
F81SL/T2	F96T12	Fluorescent, (1) 96", STD lamp, Tandem 2-lamp ballast	8' 1-Lamp T12	Electronic	1	75	55	15.5
F82SL	F96T12	Fluorescent, (2) 96", STD lamps	8' 2-Lamp T12	Electronic	2	75	110	15.5
F83SL	F96T12	Fluorescent, (3) 96", STD lamps	8' 3-Lamp T12	Electronic	3	75	179	15.5
F84SL	F96T12	Fluorescent, (4) 96", STD lamps	8' 4-Lamp T12	Electronic	4	75	220	15.5
F81EE	F96T12/ES	Fluorescent, (1) 96" ES lamp	8' 4-Lamp T12ES	Mag-ES	1	60	75	8.5
F81EE/T2	F96T12/ES	Fluorescent, (1) 96", ES lamp, Tandem 2-lamp ballast	8' 1-Lamp T12ES	Mag-ES	1	60	62	8.5
F81EL	F96T12/ES	Fluorescent, (1) 96", ES lamp	8' 1-Lamp T12ES	Electronic	1	60	69	15.5
F81EL/T2	F96T12/ES	Fluorescent, (1) 96", ES lamp, Tandem 2-lamp ballast	8' 1-Lamp T12ES	Electronic	1	60	55	15.5
F82EE	F96T12/ES	Fluorescent, (2) 96", ES lamps	8' 2-Lamp T12ES	Mag-ES	2	60	123	8.5
F82EL	F96T12/ES	Fluorescent, (2) 96", ES lamps	8' 2-Lamp T12ES	Electronic	2	60	110	15.5
F83EE	F96T12/ES	Fluorescent, (3) 96", ES lamps	8' 3-Lamp T12ES	Mag-ES	3	60	198	8.5
F83EL	F96T12/ES	Fluorescent, (3) 96", ES lamps	8' 3-Lamp T12ES	Electronic	3	60	179	15.5
F84EE	F96T12/ES	Fluorescent, (4) 96", ES lamps	8' 4-Lamp T12ES	Mag-ES	4	60	246	8.5
F84EL	F96T12/ES	Fluorescent, (4) 96", ES lamps	8' 4-Lamp T12ES	Electronic	4	60	220	15.5
F86EE	F96T12/ES	Fluorescent, (6) 96", ES lamps	8' 6-Lamp T12ES	Mag-ES	6	60	369	8.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F81SHS	F96T12/HO	Fluorescent, (1) 96", STD HO lamp	8' 1-Lamp T12HO	Mag-STD	1	110	121	8.5
F82SHE	F96T12/HO	Fluorescent, (2) 96", STD HO lamps	8' 2-Lamp T12HO	Mag-ES	2	110	207	8.5
F82SHL	F96T12/HO	Fluorescent, (2) 96", STD HO lamps	8' 2-Lamp T12HO	Electronic	2	110	173	15.5
F82SHS	F96T12/HO	Fluorescent, (2) 96", STD HO lamps	8' 2-Lamp T12HO	Mag-STD	2	110	207	8.5
F83SHE	F96T12/HO	Fluorescent, (3) 96", STD HO lamps	8' 3-Lamp T12HO	Mag-ES	3	110	319	8.5
F83SHS	F96T12/HO	Fluorescent, (3) 96", STD HO lamps	8' 3-Lamp T12HO	Mag-STD	3	110	319	8.5
F84SHE	F96T12/HO	Fluorescent, (4) 96", STD HO lamps	8' 4-Lamp T12HO	Mag-ES	4	110	414	8.5
F84SHL	F96T12/HO	Fluorescent, (4) 96", STD HO lamps	8' 4-Lamp T12HO	Electronic	4	110	346	15.5
F84SHS	F96T12/HO	Fluorescent, (4) 96", STD HO lamps	8' 4-Lamp T12HO	Mag-STD	4	110	414	8.5
F88SHS	F96T12/HO	Fluorescent, (8) 96", STD HO lamps	8' 8-Lamp T12HO	Mag-STD	8	110	828	8.5
F81EHL	F96T12/HO/ ES	Fluorescent, (1) 96", ES HO lamp	8' 1-Lamp T12ES HO	Electronic	1	95	80	15.5
F81EHS	F96T12/HO/ ES	Fluorescent, (1) 96", ES HO lamp	8' 1-Lamp T12ES HO	Mag-STD	1	95	113	8.5
F82EHE	F96T12/HO/ ES	Fluorescent, (2) 96", ES HO lamps	8' 2-Lamp T12ES HO	Mag-ES	2	95	207	8.5
F82EHL	F96T12/HO/ ES	Fluorescent, (2) 96", ES HO lamps	8' 2-Lamp T12ES HO	Electronic	2	95	173	15.5
F82EHS	F96T12/HO/	Fluorescent, (2) 96", ES HO lamps	8' 2-Lamp T12ES HO	Mag-STD	2	95	207	8.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
	ES							
F83EHE	F96T12/HO/ ES	Fluorescent, (3) 96", ES HO lamps, (1) 2-lamp ES Ballast and (1) 1-lamp STD Ballast	8' 3-Lamp T12ES HO	Mag-ES/STD	3	95	319	8.5
F83EHS	F96T12/HO/ ES	Fluorescent, (3) 96", ES HO lamps	8' 3-Lamp T12ES HO	Mag-STD	3	95	319	8.5
F84EHE	F96T12/HO/ ES	Fluorescent, (4) 96", ES HO lamps	8' 4-Lamp T12ES HO	Mag-ES	4	95	414	8.5
F84EHL	F96T12/HO/ ES	Fluorescent, (4) 96", ES HO lamps	8' 4-Lamp T12ES HO	Electronic	4	95	346	15.5
F84EHS	F96T12/HO/ ES	Fluorescent, (4) 96", ES HO lamps	8' 4-Lamp T12ES HO	Mag-STD	4	95	414	8.5
F86EHS	F96T12/HO/ ES	Fluorescent, (6) 96", ES HO lamps	8' 6-Lamp T12ES HO	Mag-STD	6	95	519	8.5
F88EHE	F96T12/HO/ ES	Fluorescent, (8) 96", ES HO lamps	8' 8-Lamp T12ES HO	Mag-ES	8	95	828	8.5
F81SVS	F96T12/VHO	Fluorescent, (1) 96", STD VHO lamp	8' 1-Lamp T12VHO	Mag-STD	1	215	205	8.5
F82SVS	F96T12/VHO	Fluorescent, (2) 96", STD VHO lamps	8' 2-Lamp T12VHO	Mag-STD	2	215	380	8.5
F83SVS	F96T12/VHO	Fluorescent, (3) 96", STD VHO lamps	8' 3-Lamp T12VHO	Mag-STD	3	215	585	8.5
F84SVS	F96T12/VHO	Fluorescent, (4) 96", STD VHO lamps	8' 4-Lamp T12VHO	Mag-STD	4	215	760	8.5
F81EVS	F96T12/VHO /ES	Fluorescent, (1) 96", ES VHO lamp	8' 1-Lamp T12ES VHO	Mag-STD	1	185	205	8.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
F82EVS	F96T12/VHO /ES	Fluorescent, (2) 96", ES VHO lamps	8' 2-Lamp T12ES VHO	Mag-STD	2	195	380	8.5
F83EVS	F96T12/VHO /ES	Fluorescent, (3) 96", ES VHO lamps	8' 3-Lamp T12ES VHO	Mag-STD	3	185	585	8.5
F84EVS	F96T12/VHO /ES	Fluorescent, (4) 96", ES VHO lamps	8' 4-Lamp T12ES VHO	Mag-STD	4	185	760	8.5
F81SGS	F96T17	Fluorescent, (1) 96", T17 Grooved lamp	8' 1-Lamp T12	Mag-STD	1	215	235	8.5
F40SE/D1	None	Fluorescent, (0) 48" lamps, Completely delamped fixture with (1) hot ballast		Mag-ES	1	0	4	8.5
F40SE/D2	None	Fluorescent, (0) 48" lamps, Completely delamped fixture with (2) hot ballast		Mag-ES	1	0	8	8.5
FC		Circline Fluorescent Fixtures						
FC6/1	FC6T9	Fluorescent, (1) 6" circular lamp, RS ballast	6" 1-Lamp T9 Cir	Mag-STD	1	20	25	15.5
FC8/1	FC8T9	Fluorescent, (1) 8" circular lamp, RS ballast	8" 1-Lamp T9 Cir	Mag-STD	1	22	26	15.5
FC8/2	FC8T9	Fluorescent, (2) 8" circular lamps, RS ballast	8" 2-Lamp T9 Cir	Mag-STD	2	22	52	15.5
FC20	FC6T9	Fluorescent, Circline, (1) 20W lamp, preheat ballast	20W 1-Lamp T9 Cir	Mag-STD	1	20	20	15.5
FC22	FC8T9	Fluorescent, Circline, (1) 22W lamp, preheat ballast	22W 1-Lamp T9 Cir	Mag-STD	1	22	20	15.5
FC12/1	FC12T9	Fluorescent, (1) 12" circular lamp, RS ballast	12" 1-Lamp T9 Cir	Mag-STD	1	32	31	15.5
FC12/2	FC12T9	Fluorescent, (2) 12" circular lamps, RS ballast	12" 2-Lamp T9 Cir	Mag-STD	2	32	62	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
FC32	FC12T9	Fluorescent, Circline, (1) 32W lamp, preheat ballast	32W 1-Lamp T9 Cir	Mag-STD	1	32	40	15.5
FC16/1	FC16T9	Fluorescent, (1) 16" circular lamp	16" 1-Lamp T9 Cir	Mag-STD	1	40	35	15.5
FC40	FC16T9	Fluorescent, Circline, (1) 32W lamp, preheat ballast	40W 1-Lamp T9 Cir	Mag-STD	1	32	42	15.5
FEI		Fluorescent Electrodeless Induction Fixtures						
FEI40/1	CFT40W	Electrodeless Fluorescent System, (1) 40W lamp	1-Lamp 40W Induction	Electronic	1	40	44	15.5
FEI55/1	CFT55W	Electrodeless Fluorescent System, (1) 55W lamp	1-Lamp 55W Induction	Electronic	1	55	59	15.5
FEI60/1	CFT60W	Electrodeless Fluorescent System, (1) 60W lamp	1-Lamp 60W Induction	Electronic	1	60	64	15.5
FEI70/1	CFT70W	Electrodeless Fluorescent System, (1) 70W lamp	1-Lamp 70W Induction	Electronic	1	70	74	15.5
FEI80/1	CFT80W	Electrodeless Fluorescent System, (1) 80W lamp	1-Lamp 80W Induction	Electronic	1	80	84	15.5
FEI85/1	CFT85W	Electrodeless Fluorescent System, (1) 85W lamp	1-Lamp 85W Induction	Electronic	1	85	89	15.5
FEI100/1	CFT100W	Electrodeless Fluorescent System, (1) 100W lamp	1-Lamp 100W Induction	Electronic	1	100	105	15.5
FEI125/1	CFT125W	Electrodeless Fluorescent System, (1) 125W lamp	1-Lamp 125W Induction	Electronic	1	125	131	15.5
FEI150/1	CFT150W	Electrodeless Fluorescent System, (1) 150W lamp	1-Lamp 150W Induction	Electronic	1	150	157	15.5
FEI165/1	CFT165W	Electrodeless Fluorescent System, (1) 165W lamp	1-Lamp 165W Induction	Electronic	1	165	173	15.5
FEI200/1	CFT200W	Electrodeless Fluorescent System, (1) 200W lamp	1-Lamp 200W Induction	Electronic	1	200	210	15.5
FEI250/1	CFT250W	Electrodeless Fluorescent System, (1) 250W lamp	1-Lamp 250W Induction	Electronic	1	250	263	15.5
FEI300/1	CFT300W	Electrodeless Fluorescent System, (1) 300W lamp	1-Lamp 300W Induction	Electronic	1	300	315	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
FEI400/1	CFT400W	Electrodeless Fluorescent System, (1) 400W lamp	1-Lamp 400W Induction	Electronic	1	400	420	15.5
FU		U-Tube Fluorescent Fixtures						
FU1ILL	FU31T8/6	Fluorescent, (1) U-Tube, T-8 lamp, Instant Start ballast	1-Lamp T8 U-Tube	Electronic	1	32	31	15.5
FU1LL	FU31T8/6	Fluorescent, (1) U-Tube, T-8 lamp	1-Lamp T8 U-Tube	Electronic	1	32	32	15.5
FU1LL-R	FU31T8/6	Fluorescent, (1) U-Tube, T-8 lamp, RLO (BF < 0.85)	1-Lamp T8 U-Tube	Electronic	1	31	27	15.5
FU2ILL	FU31T8/6	Fluorescent, (2) U-Tube, T-8 lamps, Instant Start Ballast	1-Lamp T8 U-Tube	Electronic	2	32	59	15.5
FU2ILL-H	FU31T8/6	Fluorescent, (2) U-Tube, T-8 lamps, Instant Start HLO Ballast	2-Lamp T8 HLO U-Tube	Electronic	2	32	65	15.5
FU2ILL-R	FU31T8/6	Fluorescent, (2) U-Tube, T-8 lamps, Instant Start RLO Ballast	2-Lamp T8 RLO U-Tube	Electronic	2	32	52	15.5
FU2ILL/T4	FU31T8/6	Fluorescent, (2) U-Tube, T-8 lamps, Instant Start Ballast, Tandem 4-lamp ballast	2-Lamp T8 U-Tube	Electronic	2	32	56	15.5
FU2ILL/T4-R	FU31T8/6	Fluorescent, (2) U-Tube, T-8 lamps, Instant Start Ballast, RLO, Tandem 4-lamp ballast	2-Lamp T8 RLO U-Tube	Electronic	2	32	49	15.5
FU2LL	FU31T8/6	Fluorescent, (2) U-Tube, T-8 lamps	2-Lamp T8 U-Tube	Electronic	2	32	60	15.5
FU2LL-R	FU31T8/6	Fluorescent, (2) U-Tube, T-8 lamps, RLO (BF < 0.85)	2-Lamp T8 RLO U-Tube	Electronic	2	31	54	15.5
FU2LL/T2	FU31T8/6	Fluorescent, (2) U-Tube, T-8 lamps, Tandem 4-lamp ballast	2-Lamp T8 U-Tube	Electronic	2	32	59	15.5
FU3ILL	FU31T8/6	Fluorescent, (3) U-Tube, T-8 lamps, Instant Start Ballast	3-Lamp T8 U-Tube	Electronic	3	32	89	15.5
FU3ILL-R	FU31T8/6	Fluorescent, (3) U-Tube, T-8 lamps, Instant Start RLO Ballast	3-Lamp T8ES U-Tube	Electronic	3	32	78	15.5
FU1ILU	FU32T8/6	Fluorescent, (1) 6" spacing U-Tube, T-8 lamp, IS Ballast, NLO (0.85 <	1-Lamp T8 6" Spacing U-	Electronic	1	32	29	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
		BF < 0.95)	Tube					
FU1ILU-H	FU32T8/6	Fluorescent, (1) 6" spacing U-Tube, T-8 lamp, IS Ballast, HLO (.95 < BF < 1.1)	1-Lamp T8 6" Spacing U-Tube HLO	Electronic	1	32	34	15.5
FU2ILU	FU32T8/6	Fluorescent, (2) 6" spacing U-Tube, T-8 lamps, IS Ballast, NLO (0.85 < BF < 0.95)	2-Lamp T8 6" Spacing U-Tube	Electronic	2	32	55	15.5
FU2ILU-R	FU32T8/6	Fluorescent, (2) 6" spacing U-Tube, T-8 lamps, IS Ballast, RLO (BF < 0.85)	2-Lamp T8 6" Spacing U-Tube RLO	Electronic	2	32	48	15.5
FU2ILU-V	FU32T8/6	Fluorescent, (2) 6" spacing U-Tube, T-8 lamps, IS Ballast, VHLO (BF > 1.1)	2-Lamp T8 6" Spacing U-Tube VHLO	Electronic	2	32	73	15.5
FU3ILU	FU32T8/6	Fluorescent, (3) 6" spacing U-Tube, T-8 lamps, IS Ballast, NLO (0.85 < BF < 0.95)	3-Lamp T8 6" Spacing U-Tube	Electronic	3	32	81	15.5
FU3ILU-R	FU32T8/6	Fluorescent, (3) 6" spacing U-Tube, T-8 lamps, IS Ballast, RLO (BF < 0.85)	3-Lamp T8 6" Spacing U-Tube RLO	Electronic	3	32	73	15.5
FU1SE	FU40T12	Fluorescent, (1) U-Tube, STD lamp	1-Lamp T12 U-Tube	Mag-ES	1	40	43	15.5
FU1SS	FU40T12	Fluorescent, (1) U-Tube, ES Lamp	1-Lamp T12 U-Tube ES	Mag-STD	1	40	43	8.5
FU2SE	FU40T12	Fluorescent, (2) U-Tube, STD lamps	2-Lamp T12 U-Tube	Mag-ES	2	40	72	15.5
FU2SL	FU40T12	Fluorescent (2) 48" U-bent Standard lamps, Electronic ballast, NLO (0.85 < BF < 0.95)	2-Lamp T12 U-Tube	Electronic	2	40	63	15.5
FU2SS	FU40T12	Fluorescent, (1) U-Tube, STD lamp, STD Mag Ballast	2-Lamp T12 U-Tube	Mag-STD	2	40	72	8.5
FU3SE	FU40T12	Fluorescent, (3) U-Tube, STD lamps	3-Lamp T12 U-Tube	Mag-ES	3	40	115	15.5
FU1EE	FU40T12/ES	Fluorescent, (1) U-Tube, ES lamp	1-Lamp T12ES U-Tube	Mag-ES	1	35	43	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
FU1ES	FU40T12/ES	Fluorescent, (1) U-Tube, ES Lamp	1-Lamp T12ES U-Tube	Mag-STD	1	34	43	8.5
FU2EE	FU40T12/ES	Fluorescent, (2) U-Tube, ES lamps	1-Lamp T12ES U-Tube	Mag-ES	2	35	72	15.5
FU2EL	FU40T12/ES	Fluorescent (2) 48" U-bent ES lamps, Electronic ballast, NLO (0.85 < BF < 0.95)	1-Lamp T12ES U-Tube	Electronic	2	34	63	15.5
FU2ES	FU40T12/ES	Fluorescent, (2) U-Tube, ES lamps	1-Lamp T12ES U-Tube	Mag-STD	1	35	72	8.5
FU3EE	FU40T12/ES	Fluorescent, (3) U-Tube, ES lamps	3-Lamp T12ES U-Tube	Mag-ES	3	35	115	15.5
H		Halogen Incandescent Fixtures						
H20/1	H20	Halogen, (1) 20W lamp	20W 1-Lamp Halogen		1	20	20	1.5
H21/1	H21	Halogen, (1) 21W lamp	21W 1-Lamp Halogen		1	21	21	1.5
H22/1	H22	Halogen, (1) 22W lamp	22W 1-Lamp Halogen		1	22	22	1.5
H23/1	H23	Halogen, (1) 23W lamp	23W 1-Lamp Halogen		1	23	23	1.5
H24/1	H24	Halogen, (1) 24W lamp	24W 1-Lamp Halogen		1	24	24	1.5
H25/1	H25	Halogen, (1) 25W lamp	25W 1-Lamp Halogen		1	25	25	1.5
H26/1	H26	Halogen, (1) 26W lamp	26W 1-Lamp Halogen		1	26	26	1.5
H27/1	H27	Halogen, (1) 27W lamp	27W 1-Lamp Halogen		1	27	27	1.5
H28/1	H28	Halogen, (1) 28W lamp	28W 1-Lamp Halogen		1	28	28	1.5
H29/1	H29	Halogen, (1) 29W lamp	29W 1-Lamp Halogen		1	29	29	1.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
H30/1	H30	Halogen, (1) 30W lamp	30W 1-Lamp Halogen		1	30	30	1.5
H31/1	H31	Halogen, (1) 31W lamp	31W 1-Lamp Halogen		1	31	31	1.5
H32/1	H32	Halogen, (1) 32W lamp	32W 1-Lamp Halogen		1	32	32	1.5
H33/1	H33	Halogen, (1) 33W lamp	33W 1-Lamp Halogen		1	33	33	1.5
H34/1	H34	Halogen, (1) 34W lamp	34W 1-Lamp Halogen		1	34	34	1.5
H35/1	H35	Halogen, (1) 35W lamp	35W 1-Lamp Halogen		1	35	35	1.5
H36/1	H36	Halogen, (1) 36W lamp	36W 1-Lamp Halogen		1	36	36	1.5
H37/1	H37	Halogen, (1) 37W lamp	37W 1-Lamp Halogen		1	37	37	1.5
H38/1	H38	Halogen, (1) 38W lamp	38W 1-Lamp Halogen		1	38	38	1.5
H39/1	H39	Halogen, (1) 39W lamp	39W 1-Lamp Halogen		1	39	39	1.5
H40/1	H40	Halogen, (1) 40W lamp	40W 1-Lamp Halogen		1	40	40	1.5
H41/1	H41	Halogen, (1) 41W lamp	41W 1-Lamp Halogen		1	41	41	1.5
H42/1	H42	Halogen, (1) 42W lamp	42W 1-Lamp Halogen		1	42	42	1.5
H43/1	H43	Halogen, (1) 43W lamp	43W 1-Lamp Halogen		1	43	43	1.5
H44/1	H44	Halogen, (1) 44W lamp	44W 1-Lamp Halogen		1	44	44	1.5
H45/1	H45	Halogen, (1) 45W lamp	45W 1-Lamp Halogen		1	45	45	1.5
H46/1	H46	Halogen, (1) 46W lamp	46W 1-Lamp Halogen		1	46	46	1.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
H47/1	H47	Halogen, (1) 47W lamp	47W 1-Lamp Halogen		1	47	47	1.5
H48/1	H48	Halogen, (1) 48W lamp	48W 1-Lamp Halogen		1	48	48	1.5
H49/1	H49	Halogen, (1) 49W lamp	49W 1-Lamp Halogen		1	49	49	1.5
H50/1	H50	Halogen, (1) 50W lamp	50W 1-Lamp Halogen		1	50	50	1.5
H51/1	H51	Halogen, (1) 51W lamp	51W 1-Lamp Halogen		1	51	51	1.5
H52/1	H52	Halogen, (1) 52W lamp	52W 1-Lamp Halogen		1	52	52	1.5
H53/1	H53	Halogen, (1) 53W lamp	53W 1-Lamp Halogen		1	53	53	1.5
H54/1	H54	Halogen, (1) 54W lamp	54W 1-Lamp Halogen		1	54	54	1.5
H55/1	H55	Halogen, (1) 55W lamp	55W 1-Lamp Halogen		1	55	55	1.5
H56/1	H56	Halogen, (1) 56W lamp	56W 1-Lamp Halogen		1	56	56	1.5
H57/1	H57	Halogen, (1) 57W lamp	57W 1-Lamp Halogen		1	57	57	1.5
H58/1	H58	Halogen, (1) 58W lamp	58W 1-Lamp Halogen		1	58	58	1.5
H59/1	H59	Halogen, (1) 59W lamp	59W 1-Lamp Halogen		1	59	59	1.5
H60/1	H60	Halogen, (1) 60W lamp	60W 1-Lamp Halogen		1	60	60	1.5
H61/1	H61	Halogen, (1) 61W lamp	61W 1-Lamp Halogen		1	61	61	1.5
H62/1	H62	Halogen, (1) 62W lamp	62W 1-Lamp Halogen		1	62	62	1.5
H63/1	H63	Halogen, (1) 63W lamp	63W 1-Lamp Halogen		1	63	63	1.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
H64/1	H64	Halogen, (1) 64W lamp	64W 1-Lamp Halogen		1	64	64	1.5
H65/1	H65	Halogen, (1) 65W lamp	65W 1-Lamp Halogen		1	65	65	1.5
H66/1	H66	Halogen, (1) 66W lamp	66W 1-Lamp Halogen		1	66	66	1.5
H67/1	H67	Halogen, (1) 67W lamp	67W 1-Lamp Halogen		1	67	67	1.5
H68/1	H68	Halogen, (1) 68W lamp	68W 1-Lamp Halogen		1	68	68	1.5
H69/1	H69	Halogen, (1) 69W lamp	69W 1-Lamp Halogen		1	69	69	1.5
H70/1	H70	Halogen, (1) 70W lamp	70W 1-Lamp Halogen		1	70	70	1.5
H71/1	H71	Halogen, (1) 71W lamp	71W 1-Lamp Halogen		1	71	71	1.5
H72/1	H72	Halogen, (1) 72W lamp	72W 1-Lamp Halogen		1	72	72	1.5
H73/1	H73	Halogen, (1) 73W lamp	73W 1-Lamp Halogen		1	73	73	1.5
H74/1	H74	Halogen, (1) 74W lamp	74W 1-Lamp Halogen		1	74	74	1.5
H75/1	H75	Halogen, (1) 75W lamp	75W 1-Lamp Halogen		1	75	75	1.5
H80/1	H80	Halogen, (1) 80W lamp	80W 1-Lamp Halogen		1	80	80	1.5
H90/1	H90	Halogen, (1) 90W lamp	90W 1-Lamp Halogen		1	90	90	1.5
H100/1	H100	Halogen, (1) 100W lamp	100W 1-Lamp Halogen		1	100	100	1.5
H150/1	H150	Halogen, (1) 150W lamp	150W 1-Lamp Halogen		1	150	150	1.5
H250/1	H250	Halogen, (1) 250W lamp	250W 1-Lamp Halogen		1	250	250	1.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
H300/1	H300	Halogen, (1) 300W lamp	300W 1-Lamp Halogen		1	300	300	1.5
H500/1	H500	Halogen, (1) 500W lamp	500W 1-Lamp Halogen		1	500	500	1.5
HPS		High Pressure Sodium Fixtures						
HPS35/1	HPS35	High Pressure Sodium, (1) 35W lamp	35W HPS		1	35	46	15.5
HPS50/1	HPS50	High Pressure Sodium, (1) 50W lamp	50W HPS		1	50	66	15.5
HPS70/1	HPS70	High Pressure Sodium, (1) 70W lamp	70W HPS		1	70	95	15.5
HPS100/1	HPS100	High Pressure Sodium, (1) 100W lamp	100W HPS		1	100	138	15.5
HPS150/1	HPS150	High Pressure Sodium, (1) 150W lamp	150W HPS		1	150	188	15.5
HPS200/1	HPS200	High Pressure Sodium, (1) 200W lamp	200W HPS		1	200	250	15.5
HPS250/1	HPS250	High Pressure Sodium, (1) 250W lamp	250W HPS		1	250	295	15.5
HPS310/1	HPS310	High Pressure Sodium, (1) 310W lamp	310W HPS		1	310	365	15.5
HPS360/1	HPS360	High Pressure Sodium, (1) 360W lamp	360W HPS		1	360	414	15.5
HPS400/1	HPS400	High Pressure Sodium, (1) 400W lamp	400W HPS		1	400	465	15.5
HPS1000/1	HPS1000	High Pressure Sodium, (1) 1000W lamp	1000W HPS		1	1000	1100	15.5
I		Standard Incandescent Fixtures						
I7.5/1	I7.5	Tungsten exit light, (1) 7.5 W lamp, used in night light application	7.5W incandescent		1	7.5	8	1.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
I10/1	I10	Incandescent, (1) 10W lamp	10W incandescent		1	10	10	1.5
I11/1	I11	Incandescent, (1) 11W lamp	11W incandescent		1	11	11	1.5
I12/1	I12	Incandescent, (1) 12W lamp	12W incandescent		1	12	12	1.5
I13/1	I13	Incandescent, (1) 13W lamp	13W incandescent		1	13	13	1.5
I14/1	I14	Incandescent, (1) 14W lamp	14W incandescent		1	14	14	1.5
I15/1	I15	Incandescent, (1) 15W lamp	15W incandescent		1	15	15	1.5
I16/1	I16	Incandescent, (1) 16W lamp	16W incandescent		1	16	16	1.5
I17/1	I17	Incandescent, (1) 17W lamp	17W incandescent		1	17	17	1.5
I18/1	I18	Incandescent, (1) 18W lamp	18W incandescent		1	18	18	1.5
I19/1	I19	Incandescent, (1) 19W lamp	19W incandescent		1	19	19	1.5
I20/1	I20	Incandescent, (1) 20W lamp	20W incandescent		1	20	20	1.5
I21/1	I21	Incandescent, (1) 21W lamp	21W incandescent		1	21	21	1.5
I22/1	I22	Incandescent, (1) 22W lamp	22W incandescent		1	22	22	1.5
I23/1	I23	Incandescent, (1) 23W lamp	23W incandescent		1	23	23	1.5
I24/1	I24	Incandescent, (1) 24W lamp	24W incandescent		1	24	24	1.5
I25/1	I25	Incandescent, (1) 25W lamp	25W incandescent		1	25	25	1.5
I26/1	I26	Incandescent, (1) 26W lamp	26W incandescent		1	26	26	1.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
I27/1	I27	Incandescent, (1) 27W lamp	27W incandescent		1	27	27	1.5
I28/1	I28	Incandescent, (1) 28W lamp	28W incandescent		1	28	28	1.5
I29/1	I29	Incandescent, (1) 29W lamp	29W incandescent		1	29	29	1.5
I30/1	I30	Incandescent, (1) 30W lamp	30W incandescent		1	30	30	1.5
I31/1	I31	Incandescent, (1) 31W lamp	31W incandescent		1	31	31	1.5
I32/1	I32	Incandescent, (1) 32W lamp	32W incandescent		1	32	32	1.5
I33/1	I33	Incandescent, (1) 33W lamp	33W incandescent		1	33	33	1.5
I34/1	I34	Incandescent, (1) 34W lamp	34W incandescent		1	34	34	1.5
I35/1	I35	Incandescent, (1) 35W lamp	35W incandescent		1	35	35	1.5
I36/1	I36	Incandescent, (1) 36W lamp	36W incandescent		1	36	36	1.5
I37/1	I37	Incandescent, (1) 37W lamp	37W incandescent		1	37	37	1.5
I38/1	I38	Incandescent, (1) 38W lamp	38W incandescent		1	38	38	1.5
I39/1	I39	Incandescent, (1) 39W lamp	39W incandescent		1	39	39	1.5
I40/1	I40	Incandescent, (1) 40W lamp	40W incandescent		1	40	40	1.5
I40E/1	I40/ES	Incandescent, (1) 40W ES lamp	40W incandescent		1	29	29	1.5
I40EL/1	I40/ES/LL	Incandescent, (1) 40W ES/LL lamp	40W incandescent		1	34	34	1.5
I41/1	I41	Incandescent, (1) 41W lamp	41W incandescent		1	41	41	1.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
I42/1	I42	Incandescent, (1) 42W lamp	42W incandescent		1	42	42	1.5
I43/1	I43	Incandescent, (1) 43W lamp	43W incandescent		1	43	43	1.5
I44/1	I44	Incandescent, (1) 44W lamp	44W incandescent		1	44	44	1.5
I45/1	I45	Incandescent, (1) 45W lamp	45W incandescent		1	45	45	1.5
I46/1	I46	Incandescent, (1) 46W lamp	46W incandescent		1	46	46	1.5
I47/1	I47	Incandescent, (1) 47W lamp	47W incandescent		1	47	47	1.5
I48/1	I48	Incandescent, (1) 48W lamp	48W incandescent		1	48	48	1.5
I49/1	I49	Incandescent, (1) 49W lamp	49W incandescent		1	49	49	1.5
I50/1	I50	Incandescent, (1) 50W lamp	50W incandescent		1	50	50	1.5
I51/1	I51	Incandescent, (1) 51W lamp	51W incandescent		1	51	51	1.5
I52/1	I52	Incandescent, (1) 52W lamp	52W incandescent		1	52	52	1.5
I53/1	I53	Incandescent, (1) 53W lamp	53W incandescent		1	53	53	1.5
I54/1	I54	Incandescent, (1) 54W lamp	54W incandescent		1	54	54	1.5
I55/1	I55	Incandescent, (1) 55W lamp	55W incandescent		1	55	55	1.5
I56/1	I56	Incandescent, (1) 56W lamp	56W incandescent		1	56	56	1.5
I57/1	I57	Incandescent, (1) 57W lamp	57W incandescent		1	57	57	1.5
I58/1	I58	Incandescent, (1) 58W lamp	58W incandescent		1	58	58	1.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
I59/1	I59	Incandescent, (1) 59W lamp	59W incandescent		1	59	59	1.5
I60/1	I60	Incandescent, (1) 60W lamp	60W incandescent		1	60	60	1.5
I60E/1	I60/ES	Incandescent, (1) 60W ES lamp	60W incandescent		1	43	43	1.5
I60EL/1	I60/ES/LL	Incandescent, (1) 60W ES/LL lamp	60W incandescent		1	52	52	1.5
I61/1	I61	Incandescent, (1) 61W lamp	61W incandescent		1	61	61	1.5
I62/1	I62	Incandescent, (1) 62W lamp	62W incandescent		1	62	62	1.5
I63/1	I63	Incandescent, (1) 63W lamp	63W incandescent		1	63	63	1.5
I64/1	I64	Incandescent, (1) 64W lamp	64W incandescent		1	64	64	1.5
I65/1	I65	Incandescent, (1) 65W lamp	65W incandescent		1	65	65	1.5
I66/1	I66	Incandescent, (1) 66W lamp	66W incandescent		1	66	66	1.5
I67/1	I67	Incandescent, (1) 67W lamp	67W incandescent		1	67	67	1.5
I68/1	I68	Incandescent, (1) 68W lamp	68W incandescent		1	68	68	1.5
I69/1	I69	Incandescent, (1) 69W lamp	69W incandescent		1	69	69	1.5
I70/1	I70	Incandescent, (1) 70W lamp	70W incandescent		1	70	70	1.5
I71/1	I71	Incandescent, (1) 71W lamp	71W incandescent		1	71	71	1.5
I72/1	I72	Incandescent, (1) 72W lamp	72W incandescent		1	72	72	1.5
I73/1	I73	Incandescent, (1) 73W lamp	73W incandescent		1	73	73	1.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
I74/1	I74	Incandescent, (1) 74W lamp	74W incandescent		1	74	74	1.5
I75/1	I75	Incandescent, (1) 75W lamp	75W incandescent		1	75	75	1.5
I75E/1	I75/ES	Incandescent, (1) 75W ES lamp	75W incandescent		1	53	53	1.5
I75EL/1	I75/ES/LL	Incandescent, (1) 75W ES/LL lamp	75W incandescent		1	67	67	1.5
I80/1	I80	Incandescent, (1) 80W lamp	80W incandescent		1	80	80	1.5
I85/1	I85	Incandescent, (1) 85W lamp	85W incandescent		1	85	85	1.5
I90/1	I90	Incandescent, (1) 90W lamp	90W incandescent		1	90	90	1.5
I93/1	I93	Incandescent, (1) 93W lamp	93W incandescent		1	93	93	1.5
I95/1	I95	Incandescent, (1) 95W lamp	95W incandescent		1	95	95	1.5
I100/1	I100	Incandescent, (1) 100W lamp	100W incandescent		1	100	100	1.5
I100E/1	I100/ES	Incandescent, (1) 100W ES lamp	100W incandescent		1	72	72	1.5
I100EL/1	I100/ES/LL	Incandescent, (1) 100W ES/LL lamp	100W incandescent		1	90	90	1.5
I110/1	I110	Incandescent, (1) 110W lamp	110W incandescent		1	110	110	1.5
I116/1	I116	Incandescent, (1) 116W lamp	116W incandescent		1	116	116	1.5
I120/1	I120	a	120W incandescent		1	120	120	1.5
I125/1	I125	Incandescent, (1) 125W lamp	125W incandescent		1	125	125	1.5
I130/1	I130	Incandescent, (1) 130W lamp	130W incandescent		1	130	130	1.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
I135/1	I135	Incandescent, (1) 135W lamp	135W incandescent		1	135	135	1.5
I150/1	I150	Incandescent, (1) 150W lamp	150W incandescent		1	150	150	1.5
I150E/1	I150/ES	Incandescent, (1) 150W ES lamp	150W incandescent		1	135	135	1.5
I150EL/1	I150/ES/LL	Incandescent, (1) 150W ES/LL lamp	150W incandescent		1	135	135	1.5
I160/1	I160	Incandescent, (1) 160W lamp	160W incandescent		1	160	160	1.5
I170/1	I170	Incandescent, (1) 170W lamp	170W incandescent		1	170	170	1.5
I200/1	I200	Incandescent, (1) 200W lamp	200W incandescent		1	200	200	1.5
I200L/1	I200/LL	Incandescent, (1) 200W LL lamp	200W incandescent		1	200	200	1.5
I250/1	I250	Incandescent, (1) 250W lamp	250W incandescent		1	250	250	1.5
I300/1	I300	Incandescent, (1) 300W lamp	300W incandescent		1	300	300	1.5
I400/1	I400	Incandescent, (1) 400W lamp	400W incandescent		1	400	400	1.5
I448/1	I448	Incandescent, (1) 448W lamp	448W incandescent		1	448	448	1.5
I500/1	I500	Incandescent, (1) 500W lamp	500W incandescent		1	500	500	1.5
I750/1	I750	Incandescent, (1) 750W lamp	750W incandescent		1	750	750	1.5
I1000/1	I1000	Incandescent, (1) 1000W lamp	1000W incandescent		1	1000	1000	1.5
I1500/1	I1500	Incandescent, (1) 1500W lamp	1500W incandescent		1	1500	1500	1.5
I2000/1	I2000	Incandescent, (1) 2000W lamp	2000W incandescent		1	2000	2000	1.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
MH		Metal Halide Fixtures - Standard, Pulse Start, or Ceramic						
MH20/1-L	MH20	Metal Halide, (1) 20W lamp	20W Metal Halide	Electronic	1	20	23	15.5
MH22/1-L	MH22	Metal Halide, (1) 22W lamp	22W Metal Halide	Electronic	1	22	26	15.5
MH32/1	MH32	Metal Halide, (1) 32W lamp, Magnetic ballast	32W Metal Halide	Magnetic	1	32	42	15.5
MH39/1	MH39	Metal Halide, (1) 39W lamp, Magnetic ballast	39W Metal Halide	Magnetic	1	39	51	15.5
MH39/1-L	MH39	Metal Halide, (1) 39W lamp	39W Metal Halide	Electronic	1	39	44	15.5
MH50/1	MH50	Metal Halide, (1) 50W lamp, Magnetic ballast	50W Metal Halide	Magnetic	1	50	64	15.5
MH50/1-L	MH50	Metal Halide, (1) 50W lamp	50W Metal Halide	Electronic	1	50	56	15.5
MH70/1	MH70	Metal Halide, (1) 70W lamp, Magnetic ballast	70W Metal Halide	Magnetic	1	70	91	15.5
MH70/1-L	MH70	Metal Halide, (1) 70W lamp	70W Metal Halide	Electronic	1	70	78	15.5
MH100/1	MH100	Metal Halide, (1) 100W lamp, Magnetic ballast	100W Metal Halide	Magnetic	1	100	124	15.5
MH100/1-L	MH100	Metal Halide, (1) 100W lamp	100W Metal Halide	Electronic	1	100	108	15.5
MH125/1	MH125	Metal Halide, (1) 125W lamp, Magnetic ballast	125W Metal Halide	Magnetic	1	125	148	15.5
MH150/1	MH150	Metal Halide, (1) 150W lamp, Magnetic ballast	150W Metal Halide	Magnetic	1	150	183	15.5
MH150/1-L	MH150	Metal Halide, (1) 150W lamp	150W Metal Halide	Electronic	1	150	163	15.5
MH175/1	MH175	Metal Halide, (1) 175W lamp, Magnetic ballast	175W Metal Halide	Magnetic	1	175	208	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
MH175/1-L	MH175	Metal Halide, (1) 175W lamp	175W Metal Halide	Electronic	1	175	196	15.5
MH200/1	MH200	Metal Halide, (1) 200W lamp, Magnetic ballast	200W Metal Halide	Magnetic	1	200	228	15.5
MH200/1-L	MH200	Metal Halide, (1) 200W lamp	200W Metal Halide	Electronic	1	200	219	15.5
MH250/1	MH250	Metal Halide, (1) 250W lamp, Magnetic ballast	250W Metal Halide	Magnetic	1	250	288	15.5
MH250/1-L	MH250	Metal Halide, (1) 250W lamp	250W Metal Halide	Electronic	1	250	275	15.5
MH320/1	MH320	Metal Halide, (1) 320W lamp, Magnetic ballast	320W Metal Halide	Magnetic	1	320	362	15.5
MH320/1-L	MH320	Metal Halide, (1) 320W lamp	320W Metal Halide	Electronic	1	320	343	15.5
MH350/1	MH350	Metal Halide, (1) 350W lamp, Magnetic ballast	350W Metal Halide	Magnetic	1	350	391	15.5
MH350/1-L	MH350	Metal Halide, (1) 350W lamp	350W Metal Halide	Electronic	1	350	375	15.5
MH360/1	MH360	Metal Halide, (1) 360W lamp, Magnetic ballast	360W Metal Halide	Magnetic	1	360	418	15.5
MH400/1	MH400	Metal Halide, (1) 400W lamp, Magnetic ballast	400W Metal Halide	Magnetic	1	400	453	15.5
MH400/1-L	MH400	Metal Halide, (1) 400W lamp	400W Metal Halide	Electronic	1	400	429	15.5
MH450/1	MH450	Metal Halide, (1) 450W lamp, Magnetic ballast	450W Metal Halide	Magnetic	1	450	499	15.5
MH450/1-	MH450	Metal Halide, (1) 450W lamp	450W Metal Halide	Electronic	1	450	486	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
L								
MH575/1	MH575	Metal Halide, (1) 575W lamp, Magnetic ballast	575W Metal Halide	Magnetic	1	575	630	15.5
MH750/1	MH750	Metal Halide, (1) 750W lamp, Magnetic ballast	750W Metal Halide	Magnetic	1	750	812	15.5
MH775/1	MH775	Metal Halide, (1) 775W lamp, Magnetic ballast	775W Metal Halide	Magnetic	1	775	843	15.5
MH875/1	MH875	Metal Halide, (1) 875W lamp	875W Metal Halide	Magnetic	1	875	939	15.5
MH1000/1	MH1000	Metal Halide, (1) 1000W lamp, Magnetic ballast	1000W Metal Halide	Magnetic	1	1000	1078	15.5
MH1000/1-L	MH1000	Metal Halide, (1) 1000W lamp	1000W Metal Halide	Electronic	1	1000	1067	15.5
MH1500/1	MH1500	Metal Halide, (1) 1500W lamp, Magnetic ballast	1500W Metal Halide	Magnetic	1	1500	1605	15.5
MH1650/1	MH1650	Metal Halide, (1) 1650W lamp	1650W Metal Halide	Magnetic	1	1650	1765	15.5
MH2000/1	MH2000	Metal Halide, (1) 2000W lamp	2000W Metal Halide	Magnetic	1	2000	2140	15.5
MV		Mercury Vapor Fixtures						
MV40/1	MV40	Mercury Vapor, (1) 40W lamp	40W Mercury Vapor		1	40	50	15.5
MV50/1	MV50	Mercury Vapor, (1) 50W lamp	50W Mercury Vapor		1	50	74	15.5
MV75/1	MV75	Mercury Vapor, (1) 75W lamp	75W Mercury Vapor		1	75	93	15.5
MV100/1	MV100	Mercury Vapor, (1) 100W lamp	100W Mercury Vapor		1	100	125	15.5
MV160/1	MV160-SB	Mercury Vapor, Self-Ballasted, (1) 160W self-ballasted lamp	160W Mercury Vapor		1	160	160	15.5
MV175/1	MV175	Mercury Vapor, (1) 175W lamp	175W Mercury Vapor		1	175	205	15.5

Fixture Code	LAMP CODE	DESCRIPTION	Layman Term	BALLAST	LAMP / FIXT	W / LAMP	W / FIXT	EUL
MV250/1	MV250	Mercury Vapor, (1) 250W lamp	250W Mercury Vapor		1	250	290	15.5
MV400/1	MV400	Mercury Vapor, (1) 400W lamp	400W Mercury Vapor		1	400	455	15.5
MV700/1	MV700	Mercury Vapor, (1) 700W lamp	700W Mercury Vapor		1	700	780	15.5
MV1000/1	MV1000	Mercury Vapor, (1) 1000W lamp	1000W Mercury Vapor		1	1000	1075	15.5