U.S. Environmental Protection Agency

Facilities Manual Volume 2: Architecture and Engineering Guidelines

Addendum I

Update of Guidelines to Include Procurement of Energy Efficient Products Required by the Energy Policy Act of 2005

July 20, 2006

FOREWARD

On August 8, 2005, the Energy Policy Act of 2005 (EPAct 2005) was signed into law. Section 104 of EPAct 2005 states that when procuring energy consuming products, all federal agencies must procure ENERGY STAR® or FEMP-designated products unless the agency can demonstrate through written documentation instances where:

1) An ENERGY STAR® or FEMP-designated product is not cost-effective over the life of the product taking energy cost savings into account.

2) No ENERGY STAR® or FEMP-designated product is reasonably available that meets the functional requirements of the agency.

In addition, Section 104 of EPAct 2005 requires the General Services Administration (GSA) and the Defense Logistics Agency (DLA) to identify all complying products and supply exclusively those products, unless the consumer agency specifies in writing that the product will not meet the agency's functional requirements or will not be cost-effective. To view a full copy of EPAct 2005, visit <http://fossil.energy.gov/epact/epact_final.pdf>.

This Addendum is meant to supplement the existing four volumes of the *EPA Facilities Manual* with the updated energy efficiency procurement requirements of EPAct 2005. Each section of this Addendum contains a table that provides energy efficiency recommendations for a specific category of energy consuming products. The recommended performance specifications found in this addendum were gathered from the U.S. Department of Energy (DoE) Federal Energy Management Program's (FEMP) Web site on energy efficiency requirements for 50 types of products commonly purchased by federal agencies <www.eere.energy.gov/femp/procurement/eep_requirements.cfm> and the ENERGY STAR® Web site <www.energystar.gov>.

Volume 2 of the *EPA Facilities Manual - Architecture and Engineering Guidelines* has been updated to include references to specific sections of this Addendum where appropriate. It should be noted, however, that not all product categories included in this Addendum are referenced in the updated version of Volume 2. To ensure awareness of all efficiency recommendations, it is recommended that individuals read this entire Addendum.

TABLE OF CONTENTS

1.0 Lighting

1.1 Compact Fluorescent Lamps

Efficiency Recommendation[a]			
To Replace Incandescent Bulb Rated at	**Necessary Light Output (Lumens [b])**	**Typical CFL Replacement Wattage [c]**	**Recommended CFL Lumens per Watt (lpW)**
Bare Bulbs [d]			
40 watts	495 or more	11 - 14 watts	45 lpW or more
60 watts	900 or more	15 - 19 watts	60 lpW or more
75 watts	1200 or more	20 - 25 watts	60 lpW or more
100 watts	1750 or more	≥29 watts	60 lpW or more
Reflector Type Bulbs			
50 watts	550 or more	17 - 19 watts	33 lpW or more
60 watts	675 or more	20 - 21 watts	40 lpW or more
75 watts	875 or more	≥22 watts	40 lpW or more

[a] Compact fluorescent lamps commonly referred to as compact fluorescent light bulbs or CFLs, are 3-4 times more efficient than standard incandescent bulbs. They produce light through fluorescing phosphors instead of a heated filament.
[b] Lumens are a measure of light output.
[c] Some more efficient lower wattage CFL's can produce equivalent light output to the corresponding incandescents (listed in left-hand column); to assure sufficient lighting, make sure the CFL replacement provides at least enough lumens.
[d] Covered bulbs have lower lumens per watt. Recommended lpw for covered lamps are as follows: less than or equal to 14 watts: 40 lpW; 15-19 watts: 48 lpW; 20-24 watts: 50 lpW; greater than or equal to 25 watts: 55 lpW.

1.2 Residential Light Fixtures

Key Product Criteria – Indoor Fixtures	
Performance Characteristic	**Specifications**
Note: Only electronic ballasts may be used to meet the requirements of this table. In addition, fixtures that utilize compact fluorescent lamps that do not have a plug-in base (i.e use a mogul, medium, or other screw base) are not eligible to earn the ENERGY STAR.	
Combined Lamp & Ballast Requirements:	

System Efficacy Per Lamp Ballast Platform in Lumens Per Watt (LPW)[1]	≥ 50 LPW for all lamp types below 30 total listed lamp watts. ≥ 60 LPW for all lamp types that are ≤ 24 inches and ≥ 30 total listed lamp watts. ≥ 70 LPW for all lamp types that are ≥ 24 inches and ≥ 30 total listed lamp watts.
Lamp Requirements:	
Lamp Life	For lamps shipped with the fixtures, the average rated life of the lamp must be > 10,000 hours. If the lamp is not shipped with the fixture, product packaging must meet the requirements set forth in the "Product Packaging for Consumer Awareness" section of this Table.
Lumen Maintenance	For lamps indicated on the fixture packaging or shipped with the fixtures, the lamp shall have an average rated lumen maintenance of at least 80% of initial lamp lumens at 40% (4,000 hours minimum) rated lamp life.
Color Rendering Index	For lamps shipped with the fixtures, the color rendering index must meet the following requirements: ≥ 80 for compact fluorescent lamps. ≥ 75 for linear fluorescent lamps. If the lamp is not shipped with the fixture, product packaging must meet the requirements set forth in the "Product Packaging for Consumer Awareness" section of this Table.
Correlated Color Temperature	For lamps shipped with the fixtures, the lamps must have one of the following designated correlated color temperatures (CCT): 2700K, 3000K, 3500K, 4100K, 5000K, or 6500K. If the lamp is not shipped with the fixture, product packaging must meet the requirements set forth in the "Product Packaging for Consumer Awareness" section of this Table.

Lamp/Lampholder Compatibility	For lamps indicated on the fixture packaging or shipped with the fixtures, lamps must utilize an ANSI/IEC standardized lamp base configuration, as defined by ANSI C81.61 and IEC 60061-1. The lampholder must be designed to accept lamps with ANSI/IEC standardized lamp base configurations for all applicable wattages. For example, if the ballast can operate lamps with multiple wattages (e.g., an 18W, 26W, or 32W lamp) then the lampholder must be designed to accept lamps with ANSI/IEC standardized lamp base configurations for all three applicable wattages. In addition, lamps shall either: • Meet the requirements of an ANSI/IEC standardized lamp specification sheet, as defined by ANSI C78.901-2001 and IEC 60901 (for compact fluorescent lamps) or ANSI C78.81-2001 and IEC 60081 (for linear lamps) if an applicable standard exists, or, • If no ANSI/IEC lamp standard exists (e.g., a spiral compact fluorescent lamp), a custom lamp specification sheet must be provided at the time of submittal. Specific lamp characteristics that should be included in the lamp specification sheet are detailed in Table 3.
Lamp Labeling Requirement	For lamps shipped with fixtures, a manufacturer designation that encompasses the lamp manufacturer name, wattage, correlated color temperature, and color rendering index must be labeled on the lamp or lamp base.
Electronic Ballast Requirements (Note: Magnetic Ballasts May Not Be Used in Indoor Fixtures):	
General	Per ANSI C82.11 Section 5 except paragraph 5.3.1.
Lamp Start Time	The time needed after switching on the lamp to start continuously and remain illuminated must be an average of one second or less.
Power Factor	$\geq$ 0.5
Lamp Current Crest Factor	$\leq$ 1.7
Maximum Measured Ballast Case Temperature During Normal Operation Inside Fixture(s)	Not to exceed the ballast manufacturer maximum recommended ballast case temperature during normal operation inside a fixture. **Note:** This performance characteristic is separate and distinct from thermal requirements established by UL, which governs safety rather than longevity of the ballast. All qualified fixtures are expected to meet this requirement, including linear, suspended, close-to-ceiling, IC, ICAT and Non-IC recessed canisters, etc. as well as those fixtures that may be exempt from UL1598.
Electromagnetic and Radio Frequency Interference	Ballast must meet FCC requirements for consumer use (FCC 47 CFR Part 18 Consumer Emission Limits)
Ballast Frequency	20 to 33 kHz or $\geq$ 40 kHz
Transient Protection	Per ANSI C82.11b, paragraph 5.10.1 (100kHz Ring Wave, 2.5kV, both common mode and differential mode, 7 strikes)

End of Life Protection	All ballasts that operate lamps sized T5 and smaller must contain an end of life protection circuit. For ballasts that operate multiple lamps and are required to have end of life protection, the ballast must shut down no more than two lamps when one of the lamps has reached end of life. For example, a fixture with one ballast and five lamps must not shut down more than the lamp that has reached end of life plus one additional lamp.
Dimming	Torchiere style portable fixtures shall be dimmable from 100% to 30%, or less, of maximum light output, or be switchable to three levels of brightness, not including the off position. Other fixture types that utilize dimmable ballasts shall be dimmable from 100% to 30%, or less, of maximum light output, or be switchable to three levels of brightness, not including the off position.
Safety - Ballasts and "Non Edison base Fluorescent Adapters"	The cover page of a safety test report or a general coverage statement must be provided to demonstrate compliance with ANSI/UL 935 or UL 1993, as appropriate.
Fixture Requirements:	
Fixture Warranty	A written warranty must be included with fixture packaging at the time of shipment, which covers repair or replacement of defective parts of the fixture housing, optics, trim and electronics (excluding the lamp) for a minimum of two years from the date of purchase.
Noise	Class A sound rating for electronic ballasts within the fixture, not to exceed a measured level of 24 dBA (audible) when the ballast is installed in the fixture.
Lamp Shipment Requirement	All indoor fixtures must be shipped with a lamp, except for the following fixture types: 1. Recessed downlight fixtures and recessed downlight retrofit kits 2. Fixtures using linear fluorescent lamps
Replaceable ballast	Ballasts in all fixtures (including portables) must be accessible and removable by an electrician without the cutting of wires and without damage to the fixture housing, trim, decorative elements or the carpentry (e.g., ceiling drywall) to which the fixture is attached.
Safety - Portable Fixtures	The cover page of a safety test report or a general coverage statement must be provided to demonstrate compliance with ANSI/UL 153.
Safety - Hardwired Fixtures	The cover page of a safety test report or a general coverage statement must be provided to demonstrate compliance with UL 1598.
Recessed Downlight Fixtures - Insulation Contact (IC)-Rated	Recessed downlight fixtures that are either IC-Rated for direct contact with insulation or non IC-Rated may qualify as ENERGY STAR. For fixtures to be considered IC-Rated they must be approved for zero clearance insulation cover (IC) by an OSHA NRTL laboratory. Recessed downlight fixtures that are IC-Rated must also meet the requirements for air tight fixtures, listed below.

Recessed Downlight Fixtures - Air Tight For Restricted Air Movement	Recessed downlight fixtures that are either air tight or not air tight may qualify as ENERGY STAR. For fixtures to be considered air tight, the housing or certified/listed accessory must have leakage less than 2.0 cubic feet per minute (CFM) at 75 Pascals (or 1.57 lbs/ft^2) when tested in accordance with ASTM E283 and shall be sealed with a gasket or caulk. For recessed downlight fixtures that are air tight, the following measures must be taken to ensure that fixtures can be properly installed and inspected: 1. Product packaging must meet the requirements set forth in the "Product Packaging for Consumer Awareness Requirements" section below. 2. The fixture itself must include a label certifying "air tight", or similar designation, to show air leakage less than 2.0 CFM at 75 Pascals when tested in accordance with ASTM E283. The label must be clearly visible to a building inspector. 3. Installation instructions must be included listing all components of the assembly that will be necessary to ensure an airtight installation and how the components should be properly installed. For example, depending on the method used to achieve air-tight operation, the instructions should alternatively show how a gasket is to be attached, what type of caulk to use and how it should be applied, or which certified airtight trim kits are designed to be installed with the luminaire housing.

Product Packaging for Consumer Awareness Requirements	**For fixtures that are not shipped with lamps,** product packaging must include a list of lamps types that would ensure ENERGY STAR quality and performance when paired with the qualifying fixture. This list must be clearly visible to the consumer on the fixture packaging. Manufacturers are not required to provide specific lamp manufacturer names and model numbers on the packaging. Rather, generic lamp listings, such as the NEMA or ANSI generic descriptions including a color designation (e.g., F32T8/830 or CFQ26W/G24q/827), will suffice. In addition, packaging should suggest that consumers select a lamp with a rated life of 10,000 hours or more. **Note: only recessed downlight fixtures, recessed downlight retrofit kits, and fixtures using linear lamps may ship without a lamp.** **For fixtures that are shipped with lamps,** product packaging language is required that clearly describes the nominal color designation of the lamp in units of Kelvin (i.e., 2700K, 3000K, 3500K, 4100K, 5000K, or 6500K). **For recessed downlight fixtures that are IC-Rated,** product packaging must clearly state this rating. The language must be clearly visible on the product packaging. The IC-Rated designation will also be included in the fixture description included in the Qualified Product list posted on the ENERGY STAR Web site. Sample language: "IC-Rated for direct contact with insulation." **For recessed downlight fixtures that are Air-Tight (AT) rated,** product packaging must clearly show that the fixture produces less air leakage than 2.0 CFM at 75 Pascals when tested in accordance with ASTM E283. The language must be clearly visible on the product packaging. The "air tight", or similar, designation will also be included in the fixture description included in the Qualified Product list posted on the ENERGY STAR Web site. Sample language: "Certified Air Tight per ASTM E283."

Additional Requirements for Indoor Recessed Downlight Retrofit Kits	
Performance Characteristic	**Specifications**
Note: The following ENERGY STAR performance requirements must be met by recessed downlight retrofit kits **in addition** to those listed in Table 1 - Indoor Fixtures, above.	
Reflectors	Reflectors must be included to maximize fixture efficiency.
Aperture	Maximum 7.0"

Air Tight For Restricted Air Movement	Only recessed downlight retrofit kits that are air tight may qualify as ENERGY STAR. For fixtures to be considered air tight, the housing or certified/listed accessory must have leakage less than 2.0 cubic feet per minute (CFM) at 75 Pascals (or 1.57 lbs/ft2) when tested in accordance with ASTM E283 and shall be sealed with a gasket or caulk. For recessed downlight retrofit fixtures, the following measures must be taken to ensure that fixtures can be properly installed and inspected: 1. Product packaging must meet the requirements set forth in the "Product Packaging for Consumer Awareness" section within this table, below. 2. The fixture itself must include a label certifying airtight or similar designation to show air leakage less than 2.0 CFM at 75 Pascals when tested in accordance with ASTM E283. The label must be clearly visible to a building inspector. 3. Installation instructions must be included listing all components of the assembly that will be necessary to ensure an airtight installation and how the components should be properly installed. For example, depending on the method used to achieve air-tight operation, the instructions should alternatively show how a gasket is to be attached, what type of caulk to use and how it should be applied, or which certified airtight trim kits are designed to be installed with the luminaire housing.
Electrical Connections	Edison lamp socket with wire "pigtail" to the ballast.
Safety - Fixture Conversions, Retrofits	Fixtures must be tested and listed by an OSHA NRTL laboratory as acceptable for compliance with NFPA 70, National Electrical Code (NEC). The cover page of a safety test report or a general coverage statement must be provided to demonstrate compliance with UL 1598 and UL 1598B.
Product Packaging for Consumer Awareness Requirements	Recessed downlight retrofit kit packaging and instructions must clearly indicate: 1. What fixture model numbers the recessed downlight retrofit kits are compatible with. 2. Whether or not the product is dimmable. If dimmable, user instructions must clearly indicate what type of dimming circuit it can be used on. 3. Any known incompatibility with photo controls, dimmers or timing devices. 4. Airtight or similar designation to show air leakage less than 2.0 CFM at 75 Pascals when tested in accordance with ASTM E283. The language must be clearly visible on the product packaging. The "air tight", or similar, designation will also be included in the fixture description included in the Qualified Product list posted on the ENERGY STAR Web site. Sample language: "Certified Air Tight per ASTM E283."

Outdoor Fixtures: Compliance Through Efficient Light Source	
Performance Characteristic	**Specifications**

Note: Only electronic ballasts may be used to meet the requirements of this table with the exception of high intensity discharge lamps, such as metal halide or high pressure sodium lamps. In these cases magnetic ballasts can still be used. In addition, fixtures that utilize compact fluorescent lamps that do not have a plug-in base (i.e use a mogul, medium, or other screw base) are not eligible to earn the ENERGY STAR. For example, a screw-based compact fluorescent lamp may not be used, though a metal halide lamp may be used.	
Combined Lamp & Ballast Requirements:	
System Efficacy Per Lamp Ballast Platform in Lumens Per Watt (LPW)	≥ 40 LPW for all lamp types below 15 total listed lamp watts. ≥ 50 LPW for all lamp types over 15 total listed lamp watts up to 30 total listed lamp watts ≥ 60 LPW for all lamp types over 30 total listed lamp watts
Lamp Requirements:	
Lamp Life	For lamps shipped with the fixtures, the average rated life of the lamp must be ≥ 10,000 hours. If the lamp is not shipped with the fixture, product packaging must meet the requirements set forth in the "Product Packaging for Consumer Awareness" section of this Table.
Lamp/Lampholder Compatibility	For lamps indicated on the fixture packaging or shipped with the fixtures, lamps must utilize an ANSI/IEC standardized lamp base configuration, as defined by ANSI C81.61 and IEC 60061-1. The lampholder must be designed to accept lamps with ANSI/IEC standardized lamp base configurations for all applicable wattages. For example, if the ballast can operate lamps with multiple wattages (e.g., an 18W, 26W, or 32W lamp) then the lampholder must be designed to accept lamps with ANSI/IEC standardized lamp base configurations for all three applicable wattages. In addition, lamps shall either: • Meet the requirements of an ANSI/IEC standardized lamp specification sheet, as defined by ANSI C78.901-2001 and IEC 60901 (for compact fluorescent lamps) or ANSI C78.81-2001 and IEC 60081 (for linear lamps) if an applicable standard exists, or, • If no ANSI-IEC lamp standard exists (e.g., a spiral compact fluorescent lamp), a custom lamp specification sheet must be provided at the time of submittal. Specific lamp and lamp base characteristics that should be included in the lamp specification sheet are detailed in Table 3.
Ballast Requirements:	
Electromagnetic and Radio Frequency Interference	Ballast must be FCC rated for consumer use (FCC 47 CFR Part 18 Consumer Emission Limits).

End of Life (EOL) Protection	All ballasts that operate lamps sized T5 and smaller must contain an end of life protection circuit, per ANSI/IEC requirements. For ballasts that operate multiple lamps and are required to have end of life protection, the ballast must shut down no more than two lamps when one of the lamps has reached end of life. For example, a fixture with one ballast and five lamps must not shut down more than the lamp that has reached end of life plus one additional lamp.
Fixture Requirements:	
Maximum Input Power	150 watts
Automatic Daylight Shutoff	The fixture must contain an integrated photosensor that automatically prevents operation during daylight hours. In addition, the control must automatically reactivate within 24 hours of a manual override or testing operation.
Fixture Warranty	A written warranty must be included with fixture packaging at shipment, which covers repair or replacement of defective parts of the fixture housing or electronics (excluding the lamp) for a minimum of two years from the date of purchase.
Replaceable ballast	Ballasts must be accessible to and removable by an electrician without the cutting of wires and without damage to the fixture housing, trim, decorative elements or the carpentry (e.g. ceiling drywall) to which the fixture is attached.
Safety	Fixtures must be compliant with NFPA 70, the National Electrical Code (NEC), including requirements for wet or damp locations (Articles 410-4a and Article 100).
Product Packaging for Consumer Awareness Requirements	For fixtures that are not shipped with lamps, product packaging must include a list of lamp types that would provide ENERGY STAR quality and performance when paired with the qualifying fixtures. This list must be clearly visible to the consumer on the fixture packaging. Manufacturers are not required to provide specific lamp manufacturer names and model numbers on the packaging. Rather, generic lamp listings, such as the NEMA or ANSI generic descriptions including a color designation (e.g., F32T8/830 or CFQ26W/G24q/827), will suffice. In addition, consumers should be directed to select a lamp with a rated life of 10,000 hours or more. Product packaging must indicate the minimum (lowest) starting temperature for the lamp and ballast platform of the fixture. If the automatic daylight shutoff control can be adjusted such that the fixture can operate during full daylight, or automatic reactivation will not occur within 24 hours of a manual override or testing operation, additional packaging language is required that provides a range of settings that will result in the fixture complying with the specification. The language must be clearly visible to the consumer on the fixture packaging **and** in the fixture manual. Sample language: "To meet ENERGY STAR requirements the photosensor control knob must be set to x, y, or z to prevent operation during full daylight."

Outdoor Fixtures: Compliance Through Reduced Operating Time	
Note: All lamp types (fluorescent, incandescent, etc.) may be used to meet the requirements set forth in this table.	
Fixture Requirements:	
Maximum Input Power	250 watts
Automatic Daylight Shutoff	The fixture must contain an integrated photosensor that automatically prevents operation during daylight hours. In addition, the control must automatically reactivate within 24 hours of a manual override or testing operation.
Motion Control	The fixture must contain an integrated motion sensor that employs infrared sensing technology. The sensor must: • Allow automatic shut-off of the lamp within 15 minutes of being manually activated by a switch or automatically activated by the sensor, and • Automatically reset to sensing mode within 24 hours of a manual override or testing operation. The fixture must: • Have an indicator that visibly or audibly informs the device operator that the motion sensor is operating properly, or that it has failed or malfunctioned.
Fixture Warranty	A written warranty must be included with fixture packaging at shipment, which covers repair or replacement of defective parts of the fixture housing or electronics (excluding the lamp) for a minimum of two years from the date of purchase.
Replaceable ballast	If a ballast is present in the fixture, it must be accessible to and removable by an electrician without the cutting of wires and without damage to the fixture housing, trim, decorative elements or the carpentry (e.g., ceiling drywall) to which the fixture is attached.
Safety	Fixtures must be compliant with NFPA 70, the National Electrical Code (NEC), including requirements for wet or damp locations (Articles 410-4a and Article 100).
Product Packaging for Consumer Awareness Requirements	If the automatic daylight shutoff control can be adjusted such that the fixture can operate during full daylight, or automatic reactivation will not occur within 24 hours of a manual override or testing operation, product packaging language is required that provides a range of settings that will result in the fixture complying with the specification. The language must be clearly visible to the consumer on the fixture packaging and in the fixture manual. Sample language: "To meet ENERGY STAR requirements the photosensor control knob must be set to x, y, or z to prevent operation during full daylight." If the integrated motion sensor can be adjusted such that shut-off will not

	occur within 15 minutes or automatic reset to sensing mode will not occur within 24 hours of a manual override or testing operation, product packaging must provide a range of settings that will resulting the fixture complying with the specification. The language must be clearly visible to the consumer on the fixture packaging and in the fixture manual. Sample language: "To meet ENERGY STAR requirements, the motion sensor control knob must be set to x, y, or z to allow automatic reset of the sensor". In addition, the fixture must include instructions within the packaging that outlines step-by-step calibration instructions for the motion sensor.

[1]Efficacy shall be determined by the following equation:

$$\text{Efficacy [Lumens per Watt]} = \frac{\text{Measured Lamp Lumens [Lumens]}}{\text{Measured Input Power [Watts]}}$$

Lamp Lumens: Lamp lumens must be measured using the lamp and ballast that are shipped with the fixture.

Input Power: Input power must be measured with the lamp and ballast that are shipped with the fixture.

Please view the ENERGY STAR guidelines for residential light fixtures <www.energystar.gov/ia/partners/prod_development/revisions/downloads/fixtures/RLF_V4FINALSpec.pdf> for definitions for terms mentioned above.

1.3 Fluorescent Tube Lamps

Efficiency Recommendation		
Lamp Type	**Recommended**	**Best Available**
Four-Foot Lamps		
T8, 32 watts	2800 lumens[a] or more	3000 lumens
T12, 34 watts	2800 lumens or more	2900 lumens
Eight-Foot Lamps		
T8,59 watts	5700 lumens or more	5950 lumens
T12,34 watts	2800 lumens or more	2900 lumens
Eight-Foot Lamps		
T8,59 watts	5700 lumens or more	5950 lumens
T12,60 watts	5600 lumens or more	6000 lumens
U-Tube Lamps		
T8/U,31-32 watts	2600 lumens or more	2850 lumens
T12/U,34 watts	2700 lumens or more	2760 lumens

[a] Lumen is a measure of light output.

1.4 Fluorescent Ballasts

Efficiency Recommendation[a]			
Lamp Type	**# of Lamps**	**Recommended BEF[a, b]**	**Best Available BEF**
Four-Foot and U-Tube Lamps			
T8,32 Watts	1	2.54 or higher	3.00
	2	1.44 or higher	1.54
	3	0.93 or higher	1.06
	4	0.73 or higher	0.79
T12,34 Watts	1	2.64 or higher	3.05
	2	1.41 or higher	1.53
	3	0.93 or higher	0.95
Eight-Foot Lamps			
T8,59 Watts	2	0.80 or higher	0.81
T12,60 Watts	2	0.80 or higher	0.80

[a] Ballast efficacy factor (BEF) is the ratio of the ballast factor (BF) to input watts; it measures the efficiency of the lamp/ballast system relative to others using the same type and number of lamps.
[b] Ballast factor (BF), also called relative light output (RLO), is the ratio of the light output of a lamp(s) operated by a ballast, to the light output of the same lamp(s) operated by a reference ballast at rated current and voltage.

1.5 Fluorescent Luminaries

Efficiency Recommendation[a]			
Luminaire[a] Type (NEMA Designation)	**Number of Lamps**	**Recommended LER[b]**	**Best Available LER[b]**
2' x 4' Recessed			
Lensed (FL)	2	62 or higher	77
	3	61 or higher	77
	4	61 or higher	77
VDT[c]-Preferred[d] Louvered (FP)	2	50 or higher	62
	3	51 or higher	68
	4	54 or higher	68
Plastic Wraparound			
Four-Foot (FW)	2	63 or higher	88
	4	62 or higher	100
Strip Lights			
Four-Foot (FS)	1	70 or higher	86
	2	70 or higher	92
Industrial			
Four-Foot (FI)	1	67 or higher	91

Eight-Foot (FI)	2	68 or higher	86
2' x 2' Recessed, for U-Tube Lamps			
VDT-Preferred	2	41 or higher	63
Lensed	2	49 or higher	78

[a] Luminaire is a complete lighting unit consisting of a fixture along with one or more ballasts and lamps.
[b] Luminaire efficacy rating (LER) describes the efficiency of a luminaire in terms of rated light output (in lumens) per watt of electricity use. (Lumen is a measure of light output.)
[c] VDTs or video display terminals (computer monitors) may be obscured by direct or reflected glare from overhead luminaires that emit light at wide angles.
[d] "VDT-Preferred" luminaires meet IESNA recommendations for glare reduction, based on maximum allowable average luminance at 55° and higher angles from vertical.

1.6 Downlight Luminaries

Efficiency Recommendation[a,b]		
Luminaire[c] Type (NEMA designation)	**Recommended LER[d]**	**Best Available LER**
Compact Fluorescent Lamps (CFLs)		
Open Optics	29 or higher	57
Baffled[e] Optics	21 or higher	41
Lensed Optics	24 or higher	48
Metal Halide Lamps		
Open Optics	35 or higher	55
Lensed Optics	30 or higher	43

[a] Downlight is a small, ceiling-mounted direct lighting unit that casts its light downward.
[b] This recommendation pertains to downlight luminaires with compact fluorescent lamps from 13 to 32 watts (about 700 - 1,400 lumens), and metal halide lamps under 150 watts (about 12,000 lumens).
[c] Luminaire is a complete lighting unit consisting of a fixture along with one or more ballasts and lamps.
[d] Luminaire efficacy rating (LER) describes the efficiency of a luminaire in terms of rated light output (in lumens) per watt of electricity use. Lumen is a measure of light output.
[e] Baffle is a light-absorbing element within the luminaire.

1.7 Industrial HID Luminaries

Efficiency Recommendation[a]					
Upward Efficiency[a]	**Lamp Wattage**	**Closed Fixture (HC) LER[b]**		**Open Fixture (HO) LER[b]**	
		Recommended	**Best Available**	**Recommended**	**Best Available**
Metal Halide Lamps					
0%	150-399	41 or higher	64	insuff. data	63
	400-999	53 or higher	67	59 or higher	69
	>1000	77 or higher	83	insuff. data	110
1%-10%	150-399	56 or higher	70	insuff. data	53

	400-999	62 or higher	67	64 or higher	70
	>1000	insuff. data	99	88 or higher	108
>20%	150-399	62 or higher	73	77 or higher	90
	400-999	65 or higher	74	insuff. data	75
	>1000	insuff. data	96	insuff. data	96
High Pressure Sodium Lamps					
0%	150-399	58 or higher	76	68 or higher	76
	400-999	63 or higher	87	84 or higher	96
	>1000	insuff. data	94	insuff. data	95
1%-10%	150-399	64 or higher	78	63 or higher	84
	400-999	82 or higher	101	89 or higher	111
	>1000	insuff. data	92	109 or higher	121
11%-20%	150-399	insuff. data	89	78 or higher	87
	400-999	insuff. data	91	94 or higher	100
	>1000	insuff. data	79	insuff. data	122
>20%	150-399	75 or higher	80	77 or higher	90
	400-999	insuff. data	102	insuff. data	103
	>1000	insuff. data	116	insuff. data	121

[a] Upward efficiency is the portion of light directed up. Both high-bay and low-bay luminaires are available with opaque reflectors, which direct all or most of the light downward, and with transparent refractors, which direct some light up.
[b] LER, or luminaire efficacy rating, describes the efficiency of a luminaire in terms of rated light output (in lumens) per watt of electricity use. A lumen is a standard measure of light output.

1.8 Exit Signs

Efficiency Recommendation		
Product Type	**Recommended**	**Best Available**
Exit Signs	5 watts or less[a]	0 watt[b]

[a] Including built-in back-up power.
[b] Photoluminescent exit signs.

1.9 Ceiling Fans

Key Product Criteria	
Equipment	**Specifications**
Ceiling Fans	Specification defines residential ceiling fan airflow efficiency on a performance basis: CFM* of airflow per watt of power consumed by the motor and controls. Efficiency is measured on each of 3 speeds.
	At low speed, fans must have a minimum airflow of 1,250 CFM* and an efficiency of 155 CFM/Watt

	Qualifying ceiling fan models must come with a minimum 30-year motor warranty; one-year component(s) warranty; and 2-year light kits warranty.
	At high speed, fans must have a minimum airflow of 5,000 CFM* and an efficiency of 75 CFM/Watt
	Integral or attachable lighting, including separately sold ceiling fan light kits, must meet certain requirements of the RLF specification. See QPI form for specific requirements.

1.10 Traffic Signals

Key Product Criteria	
Equipment	**Specifications**
Traffic Signals	Specification based on a low energy requirement and conformance to the minimum performance requirements of the appropriate Institute for Transportation Engineers (ITE) specification.

1.11 Lighting Controls

Typical Lighting Control Applications			
Type of Control	**Private Office**	**Open Office - Daylit**	**Open Office - Interior**
Occupancy Sensors	++	++	++
Time Scheduling	+	++	++
Daylight Dimming	++	++	0
Bi-Level Switching	++	+	+
Demand Lighting	+	++	++

++ = good savings potential
+ = some savings potential
0 = not applicable

1.12 More Lighting Guidance

More Lighting Guidance

- Lighting represents the single greatest opportunity to save energy and improve working environments. The following tools can help energy managers identify lighting opportunities and effective lighting solutions. Some of the following documents are available as Adobe Acrobat PDFs.
- Benefits of Energy Effective Lighting <www.eere.energy.gov/femp/pdfs/benefits_eel.pdf>.
- Economics of Energy Effective Lighting for Offices <www.eere.energy.gov/femp/pdfs/economics_eel.pdf>.
- Effective Lighting Checklist <www.eere.energy.gov/femp/pdfs/lighting_checklst.pdf>.

- Energy-Efficient Berkeley Lamp <www.eere.energy.gov/femp/procurement/eep_berkeleylamp.cfm>.
- Federal Lighting Guide (www.eere.energy.gov/femp/pdfs/fed_light_gde.pdf)—contains information on how to implement lighting improvement projects at Federal facilities and provides references to more specific information. Rather than attempting to answer technical questions in great depth, the guide is a "one-stop-shopping" resource that directs building and energy managers to a broad range of lighting topics.
- Lighting Retrofit Workbook (www.eere.energy.gov/femp/pdfs/NPS_guidebook.pdf)—A practical guide for retrofitting lighting at National Park Service Visitors Centers. It contains useful information for all facility managers.
- Lighting Videotape: A videotape on energy-efficient lighting technologies can be ordered through the FEMP Help Desk at (877) 337-3463.
- Master Specification: Energy Efficient Lighting Technologies for Existing Federal Facilities (www.eere.energy.gov/femp/pdfs/lighting_spec2.pdf)—Boilerplate specifications for lighting are an essential part of any project that includes acquiring lighting equipment for Federal buildings. During the past 15 years, there has been such a profusion of new lighting technologies that even experts are hard pressed to keep abreast of new developments. The Master Specification for lighting helps Federal managers take advantage of new technologies by devising language that establishes baselines and requirements for lighting projects. They are intended to help Federal managers build scopes of work that will deliver the best results. These regularly updated lighting specifications are distilled from the practical experience of lighting professionals and applicable Codes of Federal Regulations.
- Tips for Using Compact Fluorescent Lamps (www.eere.energy.gov/femp/pdfs/lighting_spec2.pdf)—Tips on using compact fluorescent lighting, payback calculator, and ENERGY STAR® requirements.

Training

- Training <www.eere.energy.gov/femp/services/training_catalog.cfm> for developing energy effective lighting projects.

Related Links

- Advanced Lighting Guidelines <www.newbuildings.org/lighting.htm>.
- BetterBulbsDirect.com <www.betterbulbsdirect.com>.

2.0 Commercial and Industrial Equipment

2.1 Commercial Unitary Air Conditioners

Efficiency Recommendation		
Product Type and Size [a]	**Recommended Level**	**Best Available**
<65 MBtu/h (3 phase)	12.0 SEER or more[b]	14.5 SEER
65 - 135 MBtu/h	11.0 EER or more 11.4 IPLV or more	11.8 EER 13.0 IPLV
>135 - 240 MBtu/h	10.8 EER or more 11.2 IPLV or more	11.5 EER 13.3 IPLV

[a] Only air-cooled single-packaged and split system units used in commercial buildings are covered. Water source units are not covered by ENERGY STAR® but look for efficiency ratings that meet or exceed these levels for air source units.
[b] When operating conditions are often close to rated conditions or in regions where there are high demand costs, look for units with the highest EER ratings that also meet or exceed this SEER.

EER (energy efficiency ratio) is the cooling capacity (in Btu/hour) of the unit divided by its electrical input (in watts) at the Air Conditioning and Refrigeration Institute's (ARI) standard peak rating condition of 95°F.

SEER (seasonal energy efficiency ratio) and IPLV (integrated part-load value) are similar to EER but weigh performance at different (peak and off-peak) conditions during the cooling season.

2.2. Air-Cooled Chillers

Efficiency Recommendation[a]		
Compressor Type and Capacity	**Part Load Optimized Chillers**	
	Recommended[b] IPLV[c] (kW/ton)	**Best Available[b] IPLV[c] (kW/ton)**
Scroll (30 - 60 tons)	0.86 or less	0.83
Reciprocating (30 - 150 tons)	0.90 or less	0.80
Screw (70 - 200 tons)	0.98 or less	0.83
Compressor Type and Capacity	**Full Load Optimized Chillers**	
	Recommended Full Load (kW/ton)	**Best Available Full Load (kW/ton)**
Scroll (30 - 60 tons)	1.23 or less	1.10
Reciprocating (30 - 150 tons)	1.23 or less	1.00
Screw (70 - 200 tons)	1.23 or less	0.94

[a] Depending on the application, buyers should specify chiller efficiency using **either** full-load **or** integrated part-load values as shown (see text).
[b] Values are based on standard rating conditions specified in ARI Standard 550/590-98. Only packaged chillers (i.e., none with remote condensers) are covered.

[c] Integrated part-load value (IPLV) is a weighted average of efficiency measurements at various part-load conditions, as described in ARI Standard 550/590-98. These weightings have changed substantially from the previous standard, ARI 590-92, lowering IPLV ratings by 10%-15% for the same equipment.

2.3 Water-Cooled Chillers

Efficiency Recommendation[a]		
Compressor Type and Capacity	**Part Load Optimized Chillers**	
	Recommended IPLV[b,c] (kW/ton)	**Best Available IPLV[b,c] (kW/ton)**
Centrifugal (150 - 299 tons)	0.52 or less	0.47
Centrifugal (300 - 2,000 tons)	0.45 or less	0.38
Rotary Screw >= 150 tons	0.49 or less	0.46
Compressor Type and Capacity	**Full Load Optimized Chillers**	
	Recommended Full Load[d] (kW/ton)	**Best Available Full-Load[d] (kW/ton)**
Centrifugal (150 - 299 tons)	0.59 or less	0.50
Centrifugal (300 - 2,000 tons)	0.56 or less	0.47
Rotary Screw >= 150 tons	0.64 or less	0.58

[a] Depending on the application, buyers should specify chiller efficiency using **either** full-load **or** integrated part-load values as shown (see text).
[b] Values are based on standard reference conditions specified in ARI standard 550/590-98.
[c] Integrated part load value (IPLV) is a weighted average of efficiency measurements at various part-load conditions, as described in ARI Standard 550/590-98. These weightings have changed substantially from the previous standard, ARI 550-92, lowering IPLV ratings by 10-15% for the same equipment.
[d] Full load efficiency is measured at peak load conditions described in ARI Standard 550/590-98.

2.4 Commercial Heat Pumps

Efficiency Recommendation		
Product Type and Size	**Recommended Level[a]**	**Best Available[b]**
Air-source[c] < 65 MBtu/h	12.0 SEER or more 7.7 HSPF or more	13.2 SEER 8.5 HSPF
Air-source 65 - 135 MBtu/h	10.1 EER or more 10.4 IPLV or more 3.2 COP or more	11.5 EER 13.4 IPLV 4.0 COP
Air-source 136 - 240 MBtu/h	9.3 EER or more 9.5 IPLV or more 3.1 COP or more	10.5 EER 12.4 IPLV 3.3 COP
Water-source[d] 65 - 135 MBtu/h	12.8 EER or more 4.5 COP or more	14.5 EER 5.0 COP

[a] Efficiency levels for air-source units sized between 65 and 240 MBtu/h meet ASHRAE 90.1 minimum efficiency requirements.

[b] The best available EER and best available COP apply to different models.
[c] Only units with 3-phase power supply are covered in this category.
[d] Water source heat pumps covered here use cooling towers and boilers as the heat transfer sink or source in a closed loop piping system. This may increase boiler energy use by lowering the return water temperature. Auxiliary pumping energy is not included in the WSHP efficiency rating.

EER (energy efficiency ratio) is the cooling capacity (in Btu/hour) of the unit divided by its electrical input (in watts) at standard peak rating conditions. SEER (seasonal energy efficiency ratio) and IPLV (integrated part-load value) are similar to EER, but weigh performance during the cooling season.

COP (Coefficient of Performance) is the heating capacity (in Btu/h) at standard heating conditions divided by its electrical input (also in Btu/h). HSPF (Heating Seasonal Performance Factor), like SEER, weighs heating performance at various conditions.

2.5 Ground-Source Heat Pumps

Efficiency Recommendation				
Product Type	**Recommended**		**Best Available [a]**	
	EER[b]	**COP[c]**	**EER[b]**	**COP[c]**
Closed Loop	14.1 or more	3.3 or more	25.8	4.9
Open Loop[d]	16.2 or more	3.6 or more	31.1	5.5

[a] The best available coefficient of performance (COP) and best available energy efficiency ratio (EER) for the open-loop system apply to different models.
[b] EER is the cooling capacity (in Btu/hour) of the unit divided by its electrical input (in watts) at standard (ARI/ISO) conditions of 77°F entering water for closed-loop models and 59°F entering water for open-loop systems.
[c] COP is the heating capacity (in Btu) of the unit divided by its electrical input (also in Btu) at standard (ARI/ISO) conditions of 32°F entering water for closed-loop models and 50°F entering water for open-loop equipment.
[d] Open-loop heat pumps, as opposed to closed-loop models, utilize "once-through" water from a well, lake or stream.

2.6 Boilers

Efficiency Recommendation[a]			
Product Type (Fuel/ Heat Medium)	**Rated Capacity (Btu/h)**	**Recommended Thermal Efficiency (e_t)[b]**	**Best Available[c] Thermal Efficiency (e_t)**
Natural Gas Water	300,000 - 2,500,000	80% e_t	86.7% e_t
	2,500,001 - 10,000,000	80% e_t	83.2% e_t
Natural Gas Steam	300,000 - 2,500,000	79% e_t	81.9% e_t
	2,500,001 - 10,000,000	80% e_t	81.2% e_t
#2 Oil Water	300,000 - 2,500,000	83% e_t	87.7% e_t

	2,500,001 - 10,000,000	83% e_t	85.5% e_t
#2 Oil Steam	300,000 - 2,500,000	83% e_t	83.9% e_t
	2,500,001 - 10,000,000	83% e_t	84.2% e_t

[a] This recommendation covers low- and medium-pressure boilers used primarily in commercial space heating applications. It does not apply to high-pressure boilers used in industrial processing and cogeneration applications.
[b] Thermal efficiency (e_t), also known as "boiler efficiency" or "overall efficiency," is the boiler's energy output divided by energy input, as defined by ANSI Z21.13. In contrast to combustion efficiency (e_c), e_t accounts for radiation and convection losses through the boiler's shell.
[c] These "best available" efficiencies do not consider condensing boilers, which are generally more efficient but are not readily ratable with ANSI Z21.13.

2.7 Distribution Transformers (Medium)

Efficiency Recommendation[a] Single Phase Percent Efficiency			
Rated Capacity (kVA)	**Low Voltage[b]**	**Medium Voltage[c]**	
	Recommended Level	**Recommended Level (Dry)**	**Recommended Level (Liquid)[d]**
10	—	—	98.3 or more
15	97.7 or more	97.6 or more	98.5 or more
25	98.0 or more	97.9 or more	98.7 or more
37.5	98.2 or more	98.1 or more	98.8 or more
50	98.3 or more	98.2 or more	98.9 or more
75	98.5 or more	98.4 or more	99.0 or more
100	98.6 or more	98.5 or more	99.0 or more
167	98.7 or more	98.7 or more	99.1 or more
250	98.8 or more	98.8 or more	99.2 or more
333	98.9 or more	98.9 or more	99.2 or more
500	—	99.0 or more	99.3 or more
667	—	99.0 or more	99.4 or more
833	—	99.1 or more	99.4 or more
Three Phase Percent Efficiency			
15	97.0 or more	96.8 or more	98.0 or more
30	97.5 or more	97.3 or more	98.3 or more
45	97.7 or more	97.6 or more	98.5 or more
75	98.0 or more	97.9 or more	98.7 or more
112.5	98.2 or more	98.1 or more	98.8 or more
150	98.3 or more	98.2 or more	98.9 or more

225	98.5 or more	98.4 or more	99.0 or more
300	98.6 or more	98.5 or more	99.0 or more
500	98.7 or more	98.7 or more	99.1 or more
750	98.8 or more	98.8 or more	99.2 or more
1000	98.9 or more	98.9 or more	99.2 or more
1500	—	99.0 or more	99.3 or more
2000	—	99.0 or more	99.4 or more
2500	—	99.1 or more	99.4 or more

[a] Energy efficiency of distribution transformers is defined by NEMA's *Standard Publication TP-1* as output kVA divided by the sum of output kVA plus losses, at a specified percent load and reference temperature.
[b] Low voltage transformers have a primary voltage of 1200 volts or less; efficiency is measured at 35% of nameplate load, at 75°C.
[c] Medium voltage transformers have a primary voltage greater than 1200 volts; efficiency is measured at 50% of nameplate load, at 75°C for dry-type transformers and 85°C for liquid-filled.
[d] Liquid-filled transformers typically use oil as a combination coolant and insulating medium. They are generally higher in efficiency but are most frequently installed outside.

2.8 Electric Motors

Legal Authorities

Federal agencies are required by the Energy Policy Act of 2005 (P.L. 109-58) and Federal Acquisition Regulations (FAR) Subpart 23.2 to specify and buy ENERGY STAR®-qualified products or, in categories with no ENERGY STAR label, FEMP-designated products which are among the highest 25 percent of equivalent products for energy efficiency.

Performance Requirement for Federal Purchases						
Nominal Efficiencies for Induction Motors Rated 600 Volts or Less (Random Wound)						
Motor Size (HP)	**Open Drip-Proof (ODP)**			**Totally Enclosed Fan-Cooled (TEFC)**		
	6-pole (1200 rpm)	**4-pole (1800 rpm)**	**2-pole (3600 rpm)**	**6-pole (1200 rpm)**	**4-pole (1800 rpm)**	**2-pole (3600 rpm)**
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	88.5	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	93.6
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	95.4	95.8	95.0	95.8	96.2	95.8
300	95.4	95.8	95.4	95.8	96.2	95.8
350	95.4	95.8	95.4	95.8	96.2	95.8
400	95.8	95.8	95.8	95.8	96.2	95.8
450	96.2	96.2	95.8	95.8	96.2	95.8
500	96.2	96.2	95.8	95.8	96.2	95.8
Nominal Efficiencies for Induction Motors Rated Medium Voltage - 5 kV or less (Form Wound)						
250 - 500	95.0	95.0	94.5	95.0	95.0	95.0

2.9 Centrifugal Pumping Systems

At this time ENERY STAR and FEMP do not have guidelines for the procurement of energy efficient centrifugal pumping systems. However, for recommendations on how to purchase these energy efficient systems, see FEMP's Web site with Purchasing Specifications for Energy-Efficient Products <www.eere.energy.gov/femp/procurement/eep_centrifugal_pump.cfm>.

3.0 Food Service Equipment

3.1 Refrigerators and Freezers

Efficiency Recommendation[a]			
Product Type	**Recommended[b]**	**Recommended[c] (24.0 cu. ft.)**	**Best Available (24.0 cu. ft.)**
Refrigerator	0.10V + 2.04 kWh/day or less	4.44 kWh/day	3.97 kWh/day
Refrigerator-Freezer	0.27AV - 0.71 kWh/day or less	7.81 kWh/day	5.86 kWh/day
Freezer	0.40V + 1.38 kWh/day or less	10.98 kWh/day	6.79 kWh/day
Ice Cream Freezer	0.39V + 0.82 kWh/day or less	10.18 kWh/day	n/a[d]

[a] This recommendation only covers solid-door, reach-in commercial refrigerators and freezers.
[b] Based on ASHRAE *Standard Test Method 117-1992 Method of Testing Closed Refrigerators*. Use the formula above to calculate the recommended daily energy consumption. "V" represents the volume of a commercial refrigerator in cubic feet. For dual temp models, "AV" represents the adjusted volume, which is the refrigerator volume plus 1.63 multiplied by the freezer volume in cubic feet.
[c] Best available energy use will vary for other sizes of commercial refrigerators and freezers.
[d] Data currently not available for models exceeding the recommended level for a 24 cubic foot commercial refrigerator.

3.2 Gas Griddles

Efficiency Recommendation[a]		
Performance Metric	**Recommended Level**	**Best Available**
Cooking Energy Efficiency[b]	38% or more	45%
Idle Energy Rate [c]	16,000 Btu/h or less	14,500 Btu/h

[a] This efficiency recommendation covers flat, 3-foot long griddles.
[b] Cooking energy efficiency based on the *ASTM Standard Test Method for the Performance of Griddles (F1275)*.
[c] Idle energy rate based on a standard 3-foot long griddle. Other griddle sizes have proportionally higher or lower levels of idle rate and annual energy use.

3.3 Gas Fryers

Efficiency Recommendation[a]		
Performance Metric	**Recommended Level**	**Best Available**
Cooking Energy Efficiency[b]	50% or more	65%
Idle Energy Rate	6,500 Btu/h or less	4,500 Btu/h

[a] This efficiency recommendation covers 15-inch open deep fat fryers, which is the standard size for most floor and countertop model open fryers.
[b] Based on the heavy-load efficiency test as prescribed by the *ASTM Standard Test Method for the Performance of Open Deep Fat Fryers (F1361)*.

3.4 Hot Food Holding Cabinets

Efficiency Recommendation[a]	
Performance Metric	**Recommended Level**
Idle Energy Rate[b]	16,000 Btu/h or less

[a] This efficiency recommendation covers full-size hot food holding cabinets. Other cabinet sized have proportionally lower levels of idle rate and annual energy use.
[b] Idle energy rate is based on the idle energy rate test as prescribed by the *ASTM Standard Test Method for the Performance of Hot Food Cabinets (F2140)*.

3.5 Pressureless Steamers

Efficiency Recommendation		
Performance Metric	**Recommended Level**	**Best Available**
Cooking Energy Efficiency[a]	50% or more	70%
Idle Energy Rate[b]	0.4 kW or less	0.2 kW

[a] Based on the full-load potato efficiency test as prescribed by the ASTM Standard Test Method for the Performance of Steam Cookers (F1484).
[b] Idle energy rate is based on a single-compartment steamer. Multiple compartment steamers will have proportionately higher idle rates.

3.6 Beverage Vending Machines

Efficiency Recommendation		
Capacity[a]	**Recommended kWh/day[b,c]**	**Best Available kWh/day[d]**
401 to 500 cans	7.2 or less	—
501 to 600 cans	7.7 or less	5.7
601 to 700 cans	8.2 or less	6.0
701 to 800 cans	8.7 or less	6.7
801 to 900 cans	9.2 or less	7.5

[a] Capacity is the number of 12 ounce cans a machine is rated to hold. Please note that while actual number held is reduced for machines vending larger products (i.e. 20 ounce plastic bottles), the rated capacity remains the same.
[b] Maximum kWh/day is shown for the most common machine capacities. For machines with other rated capacities use this formula:
Y = 0.55[8.66+(0.009*C)], where Y = kWh/day and C = capacity.
[c] Energy use based on the Canadian standard test procedure CAN/CSA 804-96 (ASHRAE Standard 32.1-1997).
[d] From the June 2003 California Energy Commission database. Note that this was the best data at the time and that more efficient products may now be available.

3.7 Water Coolers

Key Product Criteria	
Equipment	**Specifications**
Water Coolers	Cold Only and Cook and Cold Bottled Units: < 0.16 kW
	Hot and Cold Bottled Units: < 1.20 kW

3.8 Ice Machines

Efficiency Recommendation[a]			
Product Type	**Ice Harvest Rate[b] lbs per 24 hrs.)**	**Recommended**	**Best Available**
Ice-Making Head[d]			
Air-Cooled	101-200	9.4 kWh or less	8.6 kWh
Air-Cooled	201-300	8.5 kWh or less	7.9 kWh
Air-Cooled	301-400	7.2 kWh or less	6.5 kWh
Air-Cooled	401-500	6.1 kWh or less	5.8 kWh
Air-Cooled	501-1000	5.8 kWh or less	5.4 kWh
Air-Cooled	1001-1500	5.5 kWh or less	5.0 kWh
Water-Cooled	201-300	6.7 kWh or less	5.9 kWh
Water-Cooled	301-500	5.5 kWh or less	4.7 kWh
Water-Cooled	501-1000	4.6 kWh or less	3.8 kWh
Water-Cooled	1001-1500	4.3 kWh or less	4.0 kWh
Water-Cooled	> 1500	4.0 kWh or less	3.5 kWh
Self-Contained[e]			
Air-Cooled	101-200	10.7 kWh or less	9.7 kWh
Water-Cooled	101-200	9.5 kWh or less	6.8 kWh
Water-Cooled	201-300	7.6 kWh or less	7.3 kWh
Remote Condensing[f]			
Air-Cooled	301-400	8.1 kWh or less	< 7.9 kWh
Air-Cooled	401-500	7.0 kWh or less	6.1 kWh
Air-Cooled	501-1000	6.2 kWh or less	5.4 kWh
Air-Cooled	1001-1500	5.1 kWh or less	4.5 kWh
Air-Cooled	> 1500	5.3 kWh or less	4.4 kWh

[a] This recommendation covers machines generating 60 grams (2 oz.) or lighter ice cubes, and does not cover flaked, crushed or fragmented ice makers.
[b] The ice harvest rate (capacity) is the amount of ice produced in 24 hours.
[c] Based on ARI Standard 810.
[d] Ice-making head units do not contain integral storage bins, but are generally designed to accommodate a variety of bin capacities. Storage bins entail additional energy use not included in the reported energy consumption figures for these units.
[e] Self-contained units contain built-in storage bins.
[f] Remote condensing units transfer the heat generated by the ice-making process outside of the building (comparable to split system air conditioners).

3.9 Spray Valves

Efficiency Recommendation				
Product Type	**Recommended**		**Best Available**	
	Flow Rate	**Cleaning Performance**[a]	**Flow Rate**	**Cleaning Performance**
Pre-Rinse Spray Valve	2.0 gpm or less @ 60 psi	26 seconds per plate or less	1.6 gpm @ 60 psi	22 seconds per plate

[a] Based on ASTM F2323-03: Standard Test Method for Pre-Rinse Spray Valves.

4.0 Appliances

4.1 Refrigerators

Efficiency Recommendation			
Refrigerator Type	**Total Volume [a]**	**Annual Energy Consumption**	
		Recommended	**Best Available [b]**
Single-Door Manual	≤2.4 cu. ft.	255 kWh or less	253 kWh
Single-Door Manual	2.5-4.4 cu. ft.	275 kWh or less	262 kWh
Single-Door Manual	4.5-6.4 cu. ft.	295 kWh or less	240 kWh
Single-Door Manual	≥6.5 cu. ft.	315 kWh or less	230 kWh
Single-Door Automatic	≤2.4 cu. ft.	305 kWh or less	—
Single-Door Automatic	2.5-4.4 cu. ft.	325 kWh or less	307 kWh
Single-Door Automatic	4.5-6.4 cu. ft.	345 kWh or less	305 kWh
Single-Door Automatic	≥6.5 cu. ft.	365 kWh or less	247 kWh
Bottom-Mount Freezer	≤18.4 cu. ft.	475 kWh or less	472 kWh
Bottom-Mount Freezer	18.5-20.4 cu. ft.	485 kWh or less	440 kWh
Bottom-Mount Freezer	≥20.5 cu. ft.	495 kWh or less	475 kWh
Top-Mount Freezer	≤8.4 cu. ft.	320 kWh or less	290 kWh
Top-Mount Freezer	8.5-10.4 cu. ft.	340 kWh or less	331 kWh
Top-Mount Freezer	10.5-12.4 cu. ft.	360 kWh or less	—
Top-Mount Freezer	12.5-14.4 cu. ft.	380 kWh or less	—
Top-Mount Freezer	14.5-16.4 cu. ft.	400 kWh or less	372 kWh
Top-Mount Freezer	16.5-18.4 cu. ft.	420 kWh or less	412 kWh
Top-Mount Freezer	18.5-20.4 cu. ft.	440 kWh or less	392 kWh
Top-Mount Freezer	20.5-22.4 cu. ft.	460 kWh or less	428 kWh
Top-Mount Freezer	22.5-24.4 cu. ft.	480 kWh or less	—
Top-Mount Freezer	≥24.5 cu. ft.	500 kWh or less	506 kWh
Side-by-Side Freezer	≤20.4 cu. ft.	560 kWh or less	—
Side-by-Side Freezer	20.5-22.4 cu. ft.	580 kWh or less	540 kWh
Side-by-Side Freezer	22.5-24.4 cu. ft.	600 kWh or less	593 kWh
Side-by-Side Freezer	≥24.5 cu. ft.	620 kWh or less	561 kWh

[a] Total volume is the sum of refrigerator and freezer volumes. Annual Energy Consumption is based on DOE test procedure.
[b] "—" indicates that data are not available on models exceeding the current national efficiency standard.

4.2 Freezers

Efficiency Recommendation			
Refrigerator Type	**Total Volume [a]**	**Annual Energy Consumption**	
		Recommended	**Best Available [b]**
Single-Door Manual	≤2.4 cu. ft.	255 kWh or less	253 kWh
Single-Door Manual	2.5-4.4 cu. ft.	275 kWh or less	262 kWh
Single-Door Manual	4.5-6.4 cu. ft.	295 kWh or less	240 kWh
Single-Door Manual	≥6.5 cu. ft.	315 kWh or less	230 kWh
Single-Door Automatic	≤2.4 cu. ft.	305 kWh or less	—
Single-Door Automatic	2.5-4.4 cu. ft.	325 kWh or less	307 kWh
Single-Door Automatic	4.5-6.4 cu. ft.	345 kWh or less	305 kWh
Single-Door Automatic	≥6.5 cu. ft.	365 kWh or less	247 kWh
Bottom-Mount Freezer	≤18.4 cu. ft.	475 kWh or less	472 kWh
Bottom-Mount Freezer	18.5-20.4 cu. ft.	485 kWh or less	440 kWh
Bottom-Mount Freezer	≥20.5 cu. ft.	495 kWh or less	475 kWh
Top-Mount Freezer	≤8.4 cu. ft.	320 kWh or less	290 kWh
Top-Mount Freezer	8.5-10.4 cu. ft.	340 kWh or less	331 kWh
Top-Mount Freezer	10.5-12.4 cu. ft.	360 kWh or less	—
Top-Mount Freezer	12.5-14.4 cu. ft.	380 kWh or less	—
Top-Mount Freezer	14.5-16.4 cu. ft.	400 kWh or less	372 kWh
Top-Mount Freezer	16.5-18.4 cu. ft.	420 kWh or less	412 kWh
Top-Mount Freezer	18.5-20.4 cu. ft.	440 kWh or less	392 kWh
Top-Mount Freezer	20.5-22.4 cu. ft.	460 kWh or less	428 kWh
Top-Mount Freezer	22.5-24.4 cu. ft.	480 kWh or less	—
Top-Mount Freezer	≥24.5 cu. ft.	500 kWh or less	506 kWh
Side-by-Side Freezer	≤20.4 cu. ft.	560 kWh or less	—
Side-by-Side Freezer	20.5-22.4 cu. ft.	580 kWh or less	540 kWh
Side-by-Side Freezer	22.5-24.4 cu. ft.	600 kWh or less	593 kWh
Side-by-Side Freezer	≥24.5 cu. ft.	620 kWh or less	561 kWh

[a] Total volume is the sum of refrigerator and freezer volumes. Annual Energy Consumption is based on DOE test procedure.
[b] "—" indicates that data are not available on models exceeding the current national efficiency standard.

4.3 Dishwashers

Efficiency Recommendation				
Product Type	**Recommended**		**Best Available**	
	kWh/yr[a]	**Energy Factor**	**kWh/yr[a]**	**Energy Factor**
Standard Dishwasher[b]	**380 or less**	**0.58 or more**	**181**	**1.11**

[a] Based on 215 wash cycles per year, where one cycle is one normal operation with a fully loaded machine.
[b] This recommendation does not cover compact models.

4.4 Clothes Washers

Efficiency Recommendation		
Washer Tub Volume	**Annual Energy Consumption[a]**	
	Recommended	**Best Available**
1.6-2.0 cu. ft.	315 kWh or less	176 kWh
2.1-2.6 cu. ft.	415 kWh or less	259 kWh
2.7-3.3 cu. ft.	520 kWh or less	282 kWh

[a] Annual energy consumption is based on 392 cycles (washings) per year (as prescribed by the DOE test method in 10 CFR 430, Sub-part B, Appendix J).

4.5 Family-Size Clothes Washers

Efficiency Recommendation		
Washer Tub Volume	**Energy Use Measurement**	
	Rated Annual Energy Use[a]	**Energy Factor**
1.9 - 2.5 cu. feet	410 kWh or less	2.5 ft.³/kWh or higher
2.6 - 3.3 cu. feet	520 kWh or less	2.5 ft.³/kWh or higher

[a] Rated annual energy use is based on 392 cycles (washings) per year, as prescribed by the Department of Energy test method for residential models (in 10 CFR 430, Sub-part B, Appendix J). However, most commercial machines are used much more frequently than this.

4.6 Room Air Conditioners

Efficiency Recommendation		
Product Type [a] and Cooling Capacity[b]	**Recommended EER[c]**	**Best Available EER[c]**
With louvers [d]; <20,000 Btu/hr	10.7 or more	11.7
With louvers; >=20,000 Btu/hr	9.42 or more	10.0

Without louvers; <8,000 Btu/hr	9.9 or more	9.6[d]
Without louvers; >=8,000 Btu/hr	9.4 or more	10.5

[a] Room air conditioning units with louvered sides are typically installed through windows. The louvered sides improve the energy performance of these units by enhancing airflow over the outdoor coil. Units intended for through-the-wall installation require a smooth-sided cabinet without louvers.
[b] Cooling capacity is the amount of cooling that can be provided by the unit (in Btu/hr) at standard rating conditions.
[c] EER, or Energy Efficiency Ratio, is equal to the measured cooling capacity of the unit (in Btu/hr) divided by its electrical input (in watts) at standard rating conditions. EER is based on DOE test procedure; see 10 CFR 430, Subpart B, Appendix F.
[d] Currently there are no models that can meet this recommendation. When purchasing a product from this category we suggest you get one with the best available EER.

4.7 Dehumidifiers

Key Product Criteria	
Equipment	**Specification**
Dehumidifiers	Energy efficiency is measured in liters of water removed per kilowatt-hour of energy consumed.
	Ranges from >= 1.20 to >= 1.50 L/kWh for standard capacity units. >= 2.25 L/kWh for high capacity units.

4.8 Room Air Cleaners

Key Product Criteria	
Equipment	**Specification**
	Must produce a minimum 50 CADR* for Dust to be considered under this specification.
	Minimum Performance Requirement: = 2.0 CADR/Watt (Dust)
	Standby Power Requirement: = 2.0 Watts Qualifying models that perform secondary consumer functions (e.g. clock, remote control) must meet the standby power requirement.
	UL Safety Requirement: Models that emit ozone as a byproduct of air cleaning must meet UL Standard 867 (ozone production must not exceed 50ppb)

*Clean Air Delivery Rate (CADR) must be measured according to the latest ANSI/AHAM AC-1 (AC-1) Standard (Go to www.aham.org for information regarding the latest edition of the AC-1 Standard).

5.0 Plumbing

5.1 Faucets

Efficiency Recommendation			
Product Type	**Flow Rate[a]**		
	Recommended	**Best Available**	**Self-Closing[b]**
Faucet[c]	2.0 gallons per minute or less	0.38 gallons per minute	0.25 gallons per cycle

[a] Based on ASME test procedure A112.18.1M-1996, with an inlet water pressure of 60 pounds per square inch (psi).
[b] Self-Closing includes both metered and automatic faucets that shutoff after a preset time, or when the user moves away.
[c] This Recommendation covers commercial and residential bathroom sink faucets.

5.2 Showerheads

Efficiency Recommendation		
Product Type	**Recommended Flow Rate[a]**	**Best Available Flow Rate**
Showerhead	2.2 gallons per minute or less	1.5 gallons per minute[b]

[a] Based on ASME test procedure A112.18.1M-1994, with an inlet water pressure of 80 pounds per square inch.
[b] Some lower-flow models exist, but shower quality is sacrificed.

5.3 Toilets

Efficiency Recommendation[a]		
Product Type	**Recommended Flush Rate[b]**	**Best Available Flush Rate**
Toilet	1.6 gpf or less	1.6 gpf

[a] Based on ASME test procedure A112.19.6-1990.
[b] The recommended flushrate applies to "flushometer" (flush valve) as well as "gravity tank" toilets, and is measured in gallons per flush (gpf). The recommended flush rate is exactly that required by the Energy Policy Act of 1992. This recommendation is issued for the purpose of promoting early replacement.

5.4 Urinals

Efficiency Recommendation		
Product Type	**Recommended Flush Rate[a]**	**Best Available Flush Rate**
Urinal	1.0 gallons or less	0.0 gallons

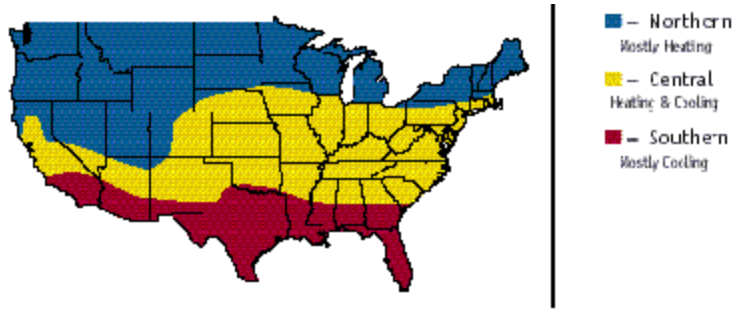
[a] Based on ASME test procedure A112.19.6-1990. The recommended flush rate is exactly that required by the Energy Policy Act of 1992. This recommendation is issued for the purpose of promoting early replacement.

6.0 Construction Products

6.1 Residential Windows

Efficiency Recommendation				
Climate Zone [a]	**Recommended** [b]		**Best Available**	
	SHGC [c]	**U-factor** [d]	**SHGC**	**U-factor**
Heating	[e]	0.35 or less	[e]	0.15
Heating & Cooling	0.55 or less	0.40 or less	0.20 [e]	0.15
Cooling	0.40 or less	0.75 or less	0.20	0.15

[a] The map below broadly identifies the relevant climate zones for the U.S.
[b] To receive these thermal performance ratings (SHGC and U-factor), windows must be certified by the National Fenestration Rating Council (NFRC).
[c] SHGC, or Solar Heat Gain Coefficient, is a measure of the solar radiation admitted through a window. SHGC ranges between 0 and 1; the lower the number, the lower the transmission of solar heat. SHGC has replaced shading coefficient (SC) as the standard indicator of a window's shading ability. SHGC is approximately equal to the SC multiplied by 0.87.
[d] U-factor is a measure of the rate of heat flow through a window. The U-factor is the inverse of the R-value, or resistance, the common measure of insulation.
[e] Low SHGCs save cooling energy but increase heating energy. Therefore, lower SHGCs are most important where cooling costs dominate.



6.2 Roof Products

Efficiency Recommendation [a,b]				
Roof Slope	**Recommended Solar Reflectance** [c,d]		**Best Available Solar Reflectance**	
	Initial	**3 Years after Installation**	**Initial**	**3 Years after Installation**
Low-slope (<2:12)	65% or greater	50% or greater	87%	85%
High-slope [e] **(>=2:12)**	25% or greater	15% or greater	77%	60%

[a] Roof products include single-ply membranes, built-up roof surfaces, asphalt shingles, metal roof tiles, and roof coatings.
[b] Following this recommendation will provide the greatest benefit where cooling energy costs exceed heating costs.
[c] Solar reflectance, or albedo, is the fraction of incoming direct and diffuse solar radiation reflected by a surface. Materials with high solar reflectance values absorb less of the sun's energy and therefore stay cooler, reducing daytime air conditioning requirements.
[d] To receive these solar reflectance ratings, roof products must be tested when new and after three years of exposure, according to ASTM E-903 and the Energy Star Roof Products Memorandum of Understanding. Initial reflectance may decrease over time, depending on the product, due to aging, dirt, and microbial accumulation.
[e] For products that can be installed on both low- and high-slope roofs, "low-slope" guidelines should be followed.

7.0 Other Efficient Technologies

7.1 Low Standby Power

Efficiency Recommendation		
Product Type	**Recommended Standby[b] Levels**	**Best Available Standby Level**
Office Equipment		
Desktop Computer[a]	2 watts or less	1 watt or less
Integrated Computer[a,c]	3.5 watts or less	3 watts or less
Laptop Computer	1 watt or less	1 watt or less
Workstation[a,d]	2 watts or less	1 watt or less
Computer Monitor	1 watt or less	1 watt or less
Printer[a]	1 watt or less	1 watt or less
Copier	1 watt or less	1 watt or less
Scanner	1 watt or less	1 watt or less
Fax/Printer	2 watts or less	1 watt or less
Multifunction Devices[a,e]	1 watt or less	1 watt or less
Docking Station	2 watts or less	1 watt or less
Audio/Video Products		
TV	1 watt or less	1 watt or less
VCR	2 watts or less	1 watt or less
TV/VCR/DVD Combo	3 watts or less	1 watt or less
DVD Players	1 watt or less	1 watt or less
Consumer Audio	1 watt or less	1 watt or less
Major Appliances		
Microwave Oven	2 watts or less	2 watts or less

[a] If this product is connected to a local area network and operated continuously, then buyers should select products with the lowest possible sleep power level.
[b] Standby power refers to the electricity used by electrical products when they are switched off or not performing their primary purpose.
[c] An "integrated computer" is a product that combines the processor and display monitor in one case and draws power through a single cord.
[d] A "workstation" is a high-performance desktop computer that can be equipped with multiple processors and is generally dedicated to computationally intensive tasks.
[e] A "multifunction device" is a product that perfroms two or more of the following: copying, faxing, scanning, or printing. Fax machines that do convenience copying (single sheet) are not considered multifunction devices for purpose of determining standby power.