4.4.6 Electric Chiller

**Description**

This measure relates to the installation of a new electric chiller meeting the efficiency standards presented below. This measure could relate to the replacement of an existing unit at the end of its useful life, or the installation of a new system in an existing building (i.e. time of sale). Only single-chiller applications should be assessed with this methodology. The characterization is not suited for multiple chillers projects or chillers equipped with variable speed drives (VSDs).

This measure was developed to be applicable to the following program types: TOS, NC. If applied to other program types, the measure savings should be verified.

**Definition of Efficient Equipment**

In order for this characterization to apply, the efficient equipment is assumed to exceed the efficiency requirements defined by the program.

**Definition of Baseline Equipment**

In order for this characterization to apply, the baseline equipment is assumed to meet the efficiency requirements within Table 403.2.3(7) of either the 2012 or the 2015 IECC, depending on the IECC in effect on the date of the building permit.

**Deemed Lifetime of Efficient Equipment**

The expected measure life is assumed to be 20 years [[1]](#footnote-1).

**Deemed Measure Cost**

The incremental capital cost for this measure is provided below.

| **Equipment Type** | **Size Category** | **Incremental Cost ($/ton)** |
| --- | --- | --- |
| Air cooled, electrically operated | All capacities | $127/ton[[2]](#footnote-3) |
| Water cooled, electrically operated, positive displacement (reciprocating) | All capacities | $22/ton[[3]](#footnote-4) |
| Water cooled, electrically operated, positive displacement (rotary screw and scroll) | < 150 tons | $351/ton[[4]](#footnote-5) |
| >= 150 tons and < 300 tons | $127/ton |
| >= 300 tons | $87/ton |

**Loadshape**

Loadshape C03 - Commercial Cooling

**Coincidence Factor**

The summer peak coincidence factor for cooling is provided in two different ways below. The first is used to estimate peak savings during the utility peak hour and is most indicative of actual peak benefits, and the second represents the *average* savings over the defined summer peak period, and is presented so that savings can be bid into PJM’s Forward Capacity Market.  Both values provided are based on analysis of Itron eShape data for Missouri, calibrated to Illinois loads, supplied by Ameren.

CFSSP = Summer System Peak Coincidence Factor for Commercial cooling (during system peak hour)

= 91.3% [[5]](#footnote-6)

CFPJM = PJM Summer Peak Coincidence Factor for Commercial cooling (average during peak period)

= 47.8% [[6]](#footnote-7)

**Algorithm**

**Calculation of Savings**

**Electric Energy Savings**

ΔkWH = TONS \* ((IPLVbase) – (IPLVee)) \* EFLH

Where:

TONS = chiller nominal cooling capacity in tons (note: 1 ton = 12,000 Btu/hr)

= Actual installed

IPLVbase = efficiency of baseline equipment expressed as Integrated Part Load Value(kW/ton). Chiller units are dependent on chiller type. See Chiller Units, Convertion Values and Baseline Efficiency Values by Chiller Type and Capacity in the Reference Tables section.

IPLVee[[7]](#footnote-8) = efficiency of high efficiency equipment expressed as Integrated Part Load Value (kW/ton)[[8]](#footnote-9)

= Actual installed

EFLH = Equivalent Full Load Hours for cooling are provided in section 4.4 HVAC End Use.

For example, a 100 ton air-cooled electrically operated chiller with IPLV of 14 EER (0.86 kW/ton) and baseline EER of 12.5 (0.96 kW/ton) ,in a low-rise office building in Rockford with a building permit dated on 1/1/2015 would save:

ΔkWH = 100 \* ((0.96) – (0.86)) \* 949

= 9,490 kWh

**Summer Coincident Peak Demand Savings**

ΔkWSSP = TONS \* ((PEbase) – (PEee)) \* CFSSP

ΔkWPJM = TONS \* ((PEbase) – (PEee)) \* CFPJM

Where:

PEbase = Peak efficiency of baseline equipment expressed as Full Load (kW/ton)

PEee = Peak efficiency of high efficiency equipment expressed as Full Load (kW/ton)

= Actual installed

CFSSP = Summer System Peak Coincidence Factor for Commercial cooling (during system peak hour)

= 91.3%

CFPJM = PJM Summer Peak Coincidence Factor for Commercial cooling (average during peak period)

= 47.8%

For example, a 100 ton air-cooled electrically operated chiller with a full load IPLV of 12 EER ( 1.0 kW/ton) and a baseline full load IPLV 9.56 EER (1.3 kW/ton) would save:

ΔkWSSP = 100 \* ((1.3) – (1.0)) \* 0.913

=27 kW

**Natural Gas Energy Savings**

N/A

**Water Impact Descriptions and Calculation**

N/A

**Deemed O&M Cost Adjustment Calculation**

N/A

**Reference Tables**

Chillers Ratings- Chillers are rated with different units depending on equipment type as shown below

| **Equipment Type** | **Unit** |
| --- | --- |
| Air cooled, electrically operated | EER |
| Water cooled, electrically operated, positive displacement (reciprocating) | kW/ton |
| Water cooled, electrically operated, positive displacement (rotary screw and scroll) | kW/ton |

In order to convert chiller equipment ratings to IPLV the following relationships are provided

kW/ton = 12 / EER

kW/ton = 12 / (COP x 3.412)

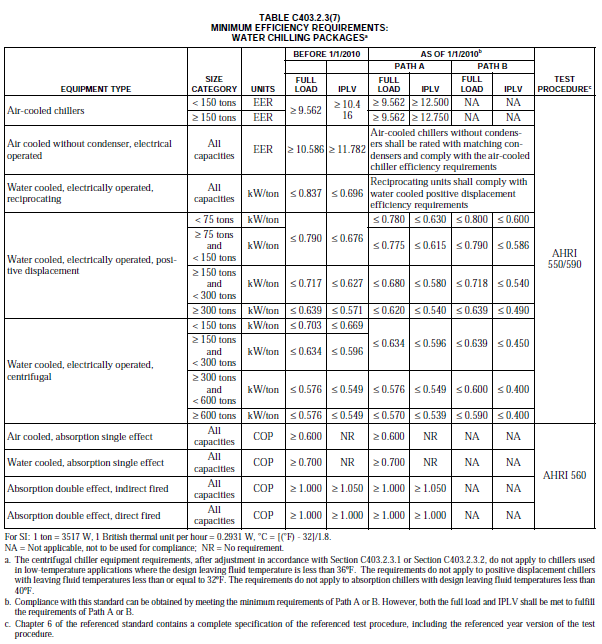
COP = EER / 3.412

COP = 12 / (kW/ton) / 3.412

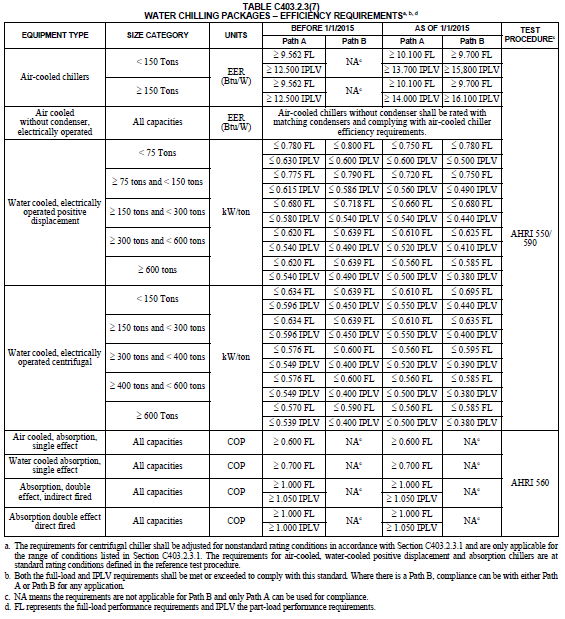
EER = 12 / kW/ton

EER = COP x 3.412

2012 IECC Baseline Efficiency Values by Chiller Type and Capacity



2015 IECC Baseline Efficiency Values by Chiller Type and Capacity



**Measure Code: CI-HVC-CHIL-V04-160601**

1. 2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05, “Effective/Remaining Useful Life Values”, California Public Utilities Commission, December 16, 2008 (http://deeresources.com/deer0911planning/downloads/EUL\_Summary\_10-1-08.xls) [↑](#footnote-ref-1)
2. 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 [↑](#footnote-ref-3)
3. 2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05, “Cost Values and Summary Documentation” [↑](#footnote-ref-4)
4. Incremental costs for water-cooled, electrically operated, 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”. [↑](#footnote-ref-5)
5. Based on analysis of Itron eShape data for Missouri, calibrated to Illinois loads, supplied by Ameren. The AC load during the utility’s peak hour is divided by the maximum AC load during the year. [↑](#footnote-ref-6)
6. Based on analysis of Itron eShape data for Missouri, calibrated to Illinois loads, supplied by Ameren. The average AC load over the PJM peak period (1-5pm, M-F, June through August) is divided by the maximum AC load during the year [↑](#footnote-ref-7)
7. Integrated Part Load Value is a seasonal average efficiency rating calculated in accordance with ARI Standard 550/590. It may be calculated using any measure of efficiency (EER, kW/ton, COP), but for consistency with IECC 2012, it is expressed in terms of IPLV here. [↑](#footnote-ref-8)
8. Can determine IPLV from standard testing or looking at engineering specs for design conditions. Standard data is available from AHRnetI.org. http://www.ahrinet.org/ [↑](#footnote-ref-9)