



HVAC
**PACKAGE TERMINAL AIR CONDITIONER
 OR HEAT PUMP, UNDER 24kBtuh**
 SWHC027-01

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MEASURE NAME

Package Terminal Air Conditioner or Heat Pump, Under 24 kBtuh

STATEWIDE MEASURE ID

SWHC027-01

TECHNOLOGY SUMMARY

Packaged terminal air conditioners (PTACs) and packaged terminal heat pumps (PTHPs) are through-the-wall units usually less than or equal to two tons of capacity and are typically used to condition small areas that have wide swings in occupancy levels. As a result, they are commonly used in hotels and motels where individual zone control is necessary.

MEASURE CASE DESCRIPTION

The measure case is defined as a package terminal air conditioner (PTAC) or a package terminal heat pump (PTHP) that is through-the-wall, self-contained, with a cooling capacity ≤ 2 tons (≤ 24 kBtuh) and an energy efficient rating (EER) that is 20% higher than the base case.

Measure Case Specification

| Installation Type | Capacity Range | Base Case (meets min. code) | | Measure Case (exceeds code by 20%) | |
|--------------------|-----------------------------|--------------------------------|---------------|---------------------------------------|---------------|
| | | AC Min EER | HP Min EER | AC Min EER | HP Min EER |
| Normal Replacement | ≤ 7,000 Btu/hr | 9.41 | 9.31 | 11.29 | 11.17 |
| | > 7,000 and ≤ 15,000 Btu/hr | 8.56 | 8.46 | 10.27 | 10.15 |
| | >15,000 Btu/hr | 7.71 | 7.61 | 9.25 | 9.13 |
| New Construction | ≤ 7,000 Btu/hr | 11.90 | 11.90 | 14.28 | 14.28 |
| | > 7,000 and ≤ 15,000 Btu/hr | 10.70 | 10.70 | 12.84 | 12.84 |
| | >15,000 Btu/hr | 9.50 | 9.50 | 11.40 | 11.40 |

Measure Offering Descriptions

| Statewide Measure Offering ID | Measure Offering Description |
|-------------------------------|---|
| SWHC027A | ≤24 kBtu/hr High Efficiency Package Terminal Air Conditioner (Non Res) DX Equipment |
| SWHC027B | ≤24 kBtu/hr High Efficiency Package Terminal Air Conditioner (Res) DX Equipment |
| SWHC027C | ≤24 kBtu/hr High Efficiency Package Terminal Heat Pump (Res) DX Equipment |
| SWHC027D | ≤24 kBtu/hr High Efficiency Package Terminal Air Conditioner (Common Area) DX Equipment |
| SWHC027E | ≤24 kBtu/hr High Efficiency Package Terminal Heat Pump (Non Res) DX Equipment |
| SWHC027F | ≤24 kBtu/hr High Efficiency Package Terminal Heat Pump (Dwelling Area) DX Equipment |
| SWHC027G | ≤24 kBtu/hr High Efficiency Package Terminal Air Conditioner (Dwelling Area) DX Equipment |

| Statewide Measure Offering ID | Measure Offering Description |
|-------------------------------|--|
| SWHC027H | <=24 kBtu/hr Package Terminal Heat Pump (Common Area) DX Equipment |

BASE CASE DESCRIPTION

The base case is defined as a package terminal air conditioner (PTAC) or package terminal heat pump (PTHP) that is through-the-wall, self-contained, with a cooling capacity ≤ 2 tons (≤ 24 kBtu/h) that meets the minimum efficiency specified in the California Building Energy Efficiency Standards (Title 24).¹ See Code Requirements.

CODE REQUIREMENTS

The minimum efficiency requirements for PTAC and PTHP < 24 kBtu/h are stipulated in the California Building Energy Efficiency Standards (Title 24).² Title 24 requirements and the formula to calculate the minimum efficiency (Table 110.2-E) are provided below.

Applicable State and Federal Codes and Standards

| Code | Applicable Code Reference | Effective Date |
|---|---------------------------|-----------------|
| CA Appliance Efficiency Regulations – Title 20 | None | n/a |
| CA Building Energy Efficiency Standards – Title 24 (2019) | Table 110.2-E | January 1, 2020 |
| Federal Standards | None | n/a |

Table 110.2-E Packaged Terminal Air Conditioners and Packaged Terminal Heat Pumps – Minimum Efficiency Requirements

| Equipment Type | Size Category (Input) | Subcategory or Rating Condition | Efficiency (EER) | Test Procedure |
|---|-----------------------|---------------------------------|--------------------------------------|------------------------|
| PTAC (Cooling mode) Newly constructed or new conditioned buildings or additions | All capacities | 95 °F db Outdoor Air | 14.0-(0.300 x cap.1000) ^a | ANSI/AHRI/C SA 310/380 |
| PTAC (Cooling mode) Replacements ^b | All capacities | 95 °F db Outdoor Air | 10.9-(0.213 x cap.1000) ^a | |

¹ California Energy Commission (CEC). 2018. *2019 Building Energy Efficiency Standards for Residential and Nonresidential Buildings (Title 24)*. CEC-400-2018-020-CMF.

² California Energy Commission (CEC). 2018. *2019 Building Energy Efficiency Standards for Residential and Nonresidential Buildings (Title 24)*. CEC-400-2018-020-CMF.

| Equipment Type | Size Category (Input) | Subcategory or Rating Condition | Efficiency (EER) | Test Procedure |
|---|-----------------------|---------------------------------|--------------------------------------|----------------|
| PTHP (Cooling mode) Newly constructed or new conditioned buildings or additions | All capacities | 95 °F db Outdoor Air | 14.0-(0.300 x cap.1000) ^a | |
| PTHP (Cooling mode) Replacements ^b | All capacities | 95 °F db Outdoor Air | 10.8-(0.213 x cap.1000) ^a | |

a. If the capacity (Cap) is < 7 kBtu/hr, use 7 kBtu/hr for the capacity. If the capacity is >15 kBtu/hr, use 15 kBtu/hr of the capacity.

b. Replacement units must be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY; NOT TO BE INSTALLED IN NEWLY CONSTRUCTED BUILDINGS." Replacement efficiencies apply only to units with existing sleeves < 16 inches high or < 42 inches wide and have a cross-sectional area < 670 square inches.

NORMALIZING UNIT

Per cooling ton

PROGRAM REQUIREMENTS

Measure Implementation Eligibility

All combinations of measure application type, delivery type, and sector that are established for this measure are specified below. Measure application type is a categorization based on the circumstances and timing of the measure installation; each measure application type is distinguished by its baseline determination, cost basis, eligibility, and documentation requirements. Delivery type is the broad categorization of the delivery channel through which the market intervention strategy (financial incentives or other services) is targeted. This table also designates the broad market sector(s) that are applicable for this measure.

Note that some of the implementation combinations below may not be allowed for some measure offerings by all program administrators.

Implementation Eligibility

| Measure Application Type | Delivery Type | Sector |
|--------------------------|---------------|--------|
| Normal Replacement | DnDeemed | Com |
| Normal Replacement | DnDeemed | Ind |
| Normal Replacement | DnDeemed | Ag |
| Normal Replacement | DnDeemed | Res |
| New Construction | DnDeemed | Com |
| New Construction | DnDeemed | Ind |
| New Construction | DnDeemed | Ag |
| New Construction | DnDeemed | Res |

Eligible Products

The package terminal air conditioning unit (PTAC) or package terminal heat pump (PTHP) must meet the measure case specification, see Measure Case Description.

Eligible Building Types and Vintages

PTACs and PTHPs are typically used to condition small areas that have wide swings in occupancy levels. As a result, they are commonly installed in hotels and motels for which individual guest room zone control is necessary. The building types that are eligible for this measure are specified below.

All existing building vintages are eligible for all building types; new construction is only available for nonresidential building types.

| Eligible Building Types | |
|----------------------------------|--|
| Health/Medical - Nursing Home | Office – Small |
| Lodging - Hotel | Restaurant - Fast-Food |
| Lodging - Guest Rooms | Retail – Small |
| Lodging - Motel | Warehouse - Refrigerated |
| Manufacturing - Bio/Tech | Residential Multi-family (Common) |
| Manufacturing - Light Industrial | Residential Multi-family (Dwelling unit) |
| Office – Large | Residential Single Family |

Eligible Climate Zones

This measure is applicable in all California climate zones.

PROGRAM EXCLUSIONS

Ductless mini-split air conditioners are not eligible.

DATA COLLECTION REQUIREMENTS

Data collection requirements are to be determined.

USE CATEGORY

HVAC

ELECTRIC SAVINGS (kWh)

The electric unit energy savings (UES) of package terminal air conditioning unit (PTAC) or package terminal heat pump (PTHP) were drawn directly from the Database of Energy Efficient Resources (DEER).

The version used to calculate savings for these measures is DEER 2005 (version D05 v2.1). The results were reported in the Remote Ex-Ante Database Interface (READI) tool (v2.4.7). The DEER Measure IDs are D03-099 (PTAC) and ID D03-101 (PTHP).

Building Type. The DEER 2005 database provided data on PTACs and PTHPs for the following building types: Lodging – Hotel and Lodging - Motel. The DEER impact values were last updated in 2014 as part of DEER 2005 v2.01. The savings for the Lodging - Motel building type were used for the lodging - motel building type as well as the residential multifamily (common area) and single family building types. The savings for lodging - hotel (guest rooms) was used for all other building types designated for this measure, including the residential multifamily (dwelling area) building type.

DEER Building Types Used for Measure Savings

| Eligible Building Type | DEER Building Type |
|-------------------------------------|--------------------|
| Health/Medical - Nursing Home | Lodging – Hotel |
| Lodging - Hotel | Lodging – Hotel |
| Lodging - Guest Rooms | Lodging – Hotel |
| Lodging - Motel | Lodging - Motel |
| Manufacturing - Bio/Tech | Lodging – Hotel |
| Manufacturing - Light Industrial | Lodging – Hotel |
| Office – Large | Lodging – Hotel |
| Office – Small | Lodging – Hotel |
| Restaurant - Fast-Food | Lodging – Hotel |
| Retail – Small | Lodging – Hotel |
| Warehouse - Refrigerated | Lodging – Hotel |
| Residential Multi-family (Common) | Lodging - Motel |
| Residential Multi-family (Dwelling) | Lodging – Hotel |
| Residential Single Family | Lodging - Motel |

Capacity Range. DEER provided data for the following unit capacity ranges for PTAC and PTHP units: < 7 kBtuh, 7 kBtuh to 15 kBtuh, and >15 kBtuh. A survey of PTAC and PTHP unit installations at a sample of hotels/motels was conducted to assess the breakdown of PTAC and PTHP unit capacity sizes that were installed over a period of 15 years. This survey data was used to estimate the distribution of installation by capacity range shown below. After evaluation of program participation data, a single capacity tier (7 kBtuh to 15 kBtuh) was determined to be used for the purpose of this measure analysis since the majority of program participation (implementation) installed units in the 7 kBtuh to 15 kBtuh capacity range.

Installation of PTAC & PTHP Units in the Lodging Sector, by Capacity Range

| Unit Capacity Range | % of Units Installed | Source |
|---------------------|----------------------|---|
| < 7 kBtuh | 5% | Southern California Edison (SCE). Proprietary data. |
| 7 kBtuh to 15 kBtuh | 90% | |
| > 15 kBtuh | 5% | |

Scaled DEER Savings Values for Title 24 Update. Savings values for normal replacement installations and new construction PTHP new construction installations were retrieved directly from DEER. However, the new construction PTAC savings were based on scaled DEER data. For new construction PTAC installations, the DEER savings were scaled down to reflect the more stringent 2016 Title 24 new construction EER requirements (see Code Requirements). The scaling was derived via building energy use simulation using the "Lodging" building type and CZ2010 weather data, based on the difference in savings between the 2016 Title 24 Standards and the DEER Standard Case. The new construction PTAC DEER energy (kWh) and demand (kW) impacts are 6.7% and 13.3%, respectively.³

³ Southern California Edison (SCE). 2019. "SWHC027-01 Savings Calcs.xlsx." See "DEER Scaler" tab.

PEAK ELECTRIC DEMAND REDUCTION (kW)

The peak demand reduction of package terminal air conditioning unit (PTAC) or package terminal heat pump (PTHP) were retrieved directly from the Database of Energy Efficient Resources (DEER). See Electric Savings.

Because the DEER values were based upon the 2 p.m. to 5 p.m. peak period, they were adjusted to reflect the peak period of the three consecutive, non-holiday weekdays from 4 p.m. to 9 p.m.⁴ and to meet the requirements of Resolution E-4867.⁵ Specifically, the DEER values were scaled on based on a prototypical model simulation for each climate zone. The most appropriate prototype model available was pulled from MAScontrol2 for a multifamily (MFm) building type. CZ2010 weather data was used to perform a model simulation for all 16 climate zones.

To calculate the appropriate scaling factor the peak demand reduction value was calculated for the previous peak period (three consecutive, non-holiday weekdays, 2 p.m. to 5 p.m.) and for the current peak period (three consecutive, non-holiday weekdays, 4 p.m. to 9 p.m.). Two scenarios were modeled for each climate zone, one for PTAC/PTHP between 7 kBtuh and 15 kBtuh and one for PTAC/PTHP greater than 15 kBtuh.⁶ The difference in the DEER peak shift between the two cases was minimal, however a weighted average ZΕΣŶŎ ΙΣĠ ΕĂŵĠ ŝŶεΙĂũũĂŝŹŶ đĂŦĠ ŹĭjбŶ ĂŶĚ †бŶ was used to determine the final scaling factor in the table below.

DEER Peak Demand Scaling Factors

| Climate Zone | DEER Peak Scaling Factor |
|--------------|--------------------------|
| CZ01 | 11% |
| CZ02 | -2% |
| CZ03 | 20% |
| CZ04 | -17% |
| CZ05 | 11% |
| CZ06 | -31% |
| CZ07 | -37% |
| CZ08 | -40% |
| CZ09 | -34% |
| CZ10 | -35% |
| CZ11 | 32% |
| CZ12 | 30% |
| CZ13 | 19% |
| CZ14 | -16% |
| CZ15 | 0% |
| CZ16 | 44% |

⁴ California Public Utilities Commission (CPUC). 2018. *Resolution E-4952*. October 11. OP 1.

⁵ California Public Utilities Commission (CPUC). 2017. *Resolution E-4867*. August 25.

⁶ Southern California Edison (SCE). 2019. "SWHC027-01 DEER Peak Shift Scalar-7-15.xlsx."

Southern California Edison (SCE). 2019. "SWHC027-01 DEER Peak Shift Scalar-15.xlsx."

Note the calculated scaling factor for CZ01 (394%) was significantly larger than the factor derived for other climate zones. This was associated with a very small actual usage in CZ01 during both peak periods. As a result, it was not prudent to use this calculated factor and the scaling factor for the climate zone with the closest 72-hour average temperature during the defined peak period days was used instead. For this scenario, CZ01 has a 72-hour average temperature of 60 °F and CZ05 was found to have the closest 72-hour average temperature of 65 °F. The 11% scaling factor for CZ05 was used to replace the model calculated factor for CZ01.

GAS SAVINGS (Therms)

Not applicable.

LIFE CYCLE

Effective useful life (EUL) is an estimate of the median number of years that a measure installed through a program is still in place and operable. Remaining useful life (RUL) is an estimate of the median number of years that a technology or piece of equipment replaced or altered by an energy efficiency program would have remained in service and operational had the program intervention not caused the replacement or alteration.

The EUL and RUL specified for package terminal air conditioning unit (PTAC) or package terminal heat pump (PHTP) are presented below. Note that RUL is only applicable for add-on equipment and accelerated replacement measures thus not applicable for this measure.

Effective Useful Life and Remaining Useful Life

| Parameter | Value | Source |
|-----------|-------|--|
| EUL (yrs) | 15.0 | California Public Utilities Commission (CPUC), Energy Division. 2003. <i>Energy Efficiency Policy Manual v 2.0</i> . California Public Utilities Commission (CPUC), Energy Division. 2008. "EUL_Summary_10-1-08.xls." |
| RUL (yrs) | n/a | n/a |

BASE CASE MATERIAL COST (\$/UNIT)

The base case costs were retrieved from the Database of Energy Efficient Resources (DEER) 2008 and validated with retailer online list prices. In total (base and measure case combined), ten online retailer spot checks were performed and found the pricing to be, on average, 6% lower than the DEER2008 costs. Based on these findings, the DEER2008 costs were adjusted to reflect this average price differential.⁷

⁷ Southern California Edison (SCE). 2019. "SWHC027-01 Cost Analysis.xlsx."

The base costs for new construction installations were determined to be consistent with normal replacements; there are some minor differences in costs between the different efficiency units, the incremental costs would be approximately the same.

Base Case Material Cost Analysis

| Base Case | DEER Cost Case ID | Base Case - Code/Standard Material Cost (DEER2008) | Base Case -Code/ Standard Material Cost (2017 Online Retailer) | Percent Differential |
|--|---------------------------------|--|--|----------------------|
| Standard Package Terminal Air Conditioner DX Equipment | PTAC-7to15kBtuh-10p16eer | \$1,061.00 | \$1,024.92 | -3% |
| Standard Package Terminal Heat Pump DX Equipment | PTHP-7to15kBtuh-9p96eer-2p91cop | \$1,104.00 | \$1,046.52 | -5% |

MEASURE CASE MATERIAL COST (\$/UNIT)

The measure case costs were retrieved from the Database of Energy Efficient Resources (DEER) 2008 and validated with retailer online list prices. In total (base and measure case combined), ten online retailer spot checks were performed; the pricing was determined to be less than 1% different from the DEER2008 costs for PTACs and 12% difference for PTHPs. Based on these findings, the DEER2008 costs were determined to be reasonable and were adopted for this measure.⁸

The measure costs for new construction installations type have been set equal to normal replacements for simplicity; there are differences in costs between the different efficiency units, the incremental costs would be approximately the same and is acceptable.

Measure Case Material Cost Analysis

| Measure Case | DEER Cost Case ID | Measure Case Material Cost (DEER2008) | Measure Case Material Cost (2017 Online Retailer) | Percent Differential |
|---|----------------------------------|---------------------------------------|---|----------------------|
| High Efficiency Package Terminal Air Conditioner DX Equipment | PTAC-7to15kBtuh-12p19eer | \$1,105.00 | \$1,101.31 | 0% |
| High Efficiency Package Terminal Heat Pump DX Equipment | PTHP-7to15kBtuh-11p95eer-3p49cop | \$1,239.00 | \$1,094.04 | -12% |

BASE CASE LABOR COST (\$/UNIT)

The base case labor installation cost was calculated as the product of labor hours adopted from the Database for Energy Efficient Resources (DEER) 2008 and labor rates reported in the 2010-2012 WO017

⁸ Southern California Edison (SCE). 2019. "SWHC027-01 Cost Analysis.xlsx."

Ex Ante Measure Cost Study conducted by Itron, Inc.⁹, for the labor with small packaged heat pump installation.

The calculated labor installation costs were converted to 2018 values using the RSMMeans 2011 and RSMMeans 2018 were used to determine the average labor rate increase to install a small packaged terminal unit. Labor rates were increased by 16% based on this analysis.¹⁰

Labor Cost Inputs

| Parameter | Value | Source |
|---------------------------------|---------|--|
| Labor Rate (\$/hr) | \$70.78 | Itron, Inc. 2014. <i>2010-2012 W0017 Ex Ante Measure Cost Study Final Report</i> . Prepared for the California Public Utilities Commission. Table 4-3. |
| Labor Rate Inflation Adjustment | 16% | Calculated |
| Labor Hours (hrs) | 6.82 | The source for this data/information is unknown. (DEER2008) |

MEASURE CASE LABOR COST (\$/UNIT)

The measure case installation labor cost is assumed to equal the installation cost for a base case unit. See Base Case Labor Cost.

NET-TO-GROSS (NTG)

The net-to-gross (NTG) ratio represents the portion of gross impacts that are determined to be directly attributed to a specific program intervention. The relevant NTG values for this measure (shown below) are based upon the average of all NTG ratios for all evaluated 2006 – 2008 commercial and residential programs, as documented in the 2011 DEER Update Study conducted by Itron, Inc. These sector average NTGs (“default NTGs”) are applicable to all energy efficiency measures that have been offered through commercial and residential sector programs for more than two years and for which impact evaluation results are not available.

Net-to-Gross Ratios

| Parameter | Value | Source |
|-------------------|-------|---|
| NTG – commercial | 0.60 | Itron, Inc. 2011. <i>DEER Database 2011 Update Documentation</i> . Prepared for the California Public Utilities Commission. Page 15-4 Table 15-3. |
| NTG – residential | 0.55 | |

⁹ Itron, Inc. 2014. *2010-2012 W0017 Ex Ante Measure Cost Study Final Report*. Prepared for the California Public Utilities Commission.

¹⁰ Southern California Edison (SCE). 2019. “SWHC027-01 Cost Analysis.xlsx.”

GROSS SAVINGS INSTALLATION ADJUSTMENT (GSIA)

The gross savings installation adjustment (GSIA) represents the ratio of the number of verified installations of the measure to the number of claimed installations reported by the utility. This factor varies by end use, sector, technology, application, and delivery method. This GSIA rate is the current “default” rate specified for measures for which an alternative GSIA has not been estimated and approved.

Gross Savings Installation Adjustment Rates

| Parameter | Value | Source |
|-----------|-------|---|
| GSIA | 1.0 | California Public Utilities Commission (CPUC), Energy Division. 2013. <i>Energy Efficiency Policy Manual Version 5</i> . Page 31. |

NON-ENERGY IMPACTS

Non-energy benefits for this measure have not been quantified.

DEER DIFFERENCES ANALYSIS

This section provides a summary of DEER-based inputs and methods, and the rationale for inputs and methods that are not DEER-based.

DEER Difference Summary

| DEER Item | Comment / Used for Workpaper |
|--------------------------------|---|
| Modified DEER methodology | Yes |
| Scaled DEER measure | Yes |
| DEER Base Case | Yes |
| DEER Measure Case | Yes |
| DEER Building Types | Yes |
| DEER Operating Hours | Yes |
| DEER eQUEST Prototypes | Yes |
| DEER Version | DEER 2017 |
| Reason for Deviation from DEER | Given assessment of program participation, the 7 kBtuh to 15 kBtuh equipment capacity measures were adopted for this measure. DEER saving values were scaled down for the new construction installation type to account for changes on the 2019 Title 24. |
| DEER Measure IDs Used | D03-099 (PTAC) and ID D03-101 (PTHP) |
| NTG | Source: DEER. The NTG of 0.60 is associated with NTG ID: <i>Com-Default>2yrs</i> , NTG of 0.55 is associated with NTG ID: <i>Res-Default>2</i> |
| GSIA | Source: DEER. The GSIA of 1.0 is associated with GSIA ID: <i>Def-GSIA</i> |
| EUL/RUL | Source: DEER. The value of 15 years is associated with EUL ID: <i>HVAC-PTAC, HVAC-PTHP, HV-ResAC, HV-ResHP</i> |

REVISION HISTORY

Measure Characterization Revision History

| Revision Number | Revision Complete Date | Primary Author, Title, Organization | Revision Summary and Rationale for Revision |
|-----------------|------------------------|-------------------------------------|---|
| 01 | 06/30/2018 | Jennifer Holmes Cal TF Staff | Draft of consolidated text for this statewide measure is based upon: SCE17HC007, Revision 1 (June 10, 2018) SCE17HC007, Revision 0 (December 14, 2016) PGECOHC114, Revision 5 (April 1, 2016) WPSDGEENRHC1052, Revision 0 (March 2, 2018) – short form Consensus reached among Cal TF members. |
| | 6/12/2019 | Joseph Ling/AESC | Recalculate PTHP and PTAC savings based on Title 24 2016 Code change and recalculated Peak Demand based on resolution E-4952. |
| | 06/26/2019 | Jennifer Holmes Cal TF Staff | Revisions for submittal of version 01. |
| | 08/09/2021 | Ajay Wadhwa, SCE | Changed E3MeaElecEndUseShapeElectric of applicable Commercial and Industrial building types from “DEER:HVAC_Eff_HP” to “DEER:HVAC_Split-Package_HP in EAD table. |
| | 08/11/2021 | Soe K Hla PG&E | Adopted all measures for PG&E. Fixed incorrect BldgType and IETableName in EAD |