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HVAC
**PACKAGE TERMINAL AIR CONDITIONER OR
HEAT PUMP, UNDER 24KBTUH**
SWHC027-02

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MEASURE NAME

High-Efficiency PTAC & Heat Pump ≤ 24 kBtu/hr

STATEWIDE MEASURE ID

SWHC027-02

TECHNOLOGY SUMMARY

Packaged Terminal Air Conditioners (PTACs) & 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 most commonly used in hotels and motels where individual zone control is necessary.

MEASURE CASE DESCRIPTION

The measure case is defined as a PTAC or PTHP that is through-the-wall, self-contained, with a cooling capacity ≤ 2 tons (≤ 24 kBtuh) and an 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	≤ 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

BASE CASE DESCRIPTION

The base case is a 2019 code compliant unit

CODE REQUIREMENTS

The minimum efficiency requirements for PTAC and PTHP < 24 kBtuh are stipulated in the California Building Energy Efficiency Standards (Title 24).¹ 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	Test Procedure ^c
PTAC (Cooling mode) Newly constructed or newly conditioned buildings or additions	All Capacities	95°F db Outdoor Air	14.0 - (0.300 x Cap/1000) ^a EER	ANSI/AHRI/CSA 310/380
PTAC (Cooling mode) Replacements ^b	All Capacities	95°F db Outdoor Air	10.9 - (0.213 x Cap/1000) ^a EER	
PTHP (Cooling mode) Newly constructed or newly conditioned buildings or additions	All Capacities	95°F db Outdoor Air	14.0 - (0.300 x Cap/1000) ^a EER	
PTHP (Cooling mode) Replacements ^b	All Capacities	95°F db Outdoor Air	10.8 - (0.213 x Cap/1000) ^a EER	

- 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

¹ Title 24 2019

PROGRAM REQUIREMENTS

Measure Implementation Eligibility

Table 4 specifies all measure application type, delivery type, and sector combinations that are established for this measure. 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.

Table 1. 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

Eligible 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 most commonly installed in hotels and motels where 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 Type
Health/Medical - Nursing Home
Lodging - Hotel
Lodging - Guest Rooms
Lodging - Motel
Manufacturing - Bio/Tech
Manufacturing - Light Industrial
Office – Large
Office – Small
Restaurant - Fast-Food
Retail – Small
Warehouse - Refrigerated

Eligible Building Type
Residential Multi-family (Common)
Residential Multi-family (Dwelling unit)
Residential Single Family

Eligible Climate Zones

This measure is applicable in any California climate zones.

PROGRAM EXCLUSIONS

Ductless mini-split air conditioners are ineligible.

DATA COLLECTION REQUIREMENTS

Data collection requirements are to be determined.

USE CATEGORY

HVAC

ELECTRIC SAVINGS (KWH)

The electric energy savings 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 (v2.5.1). The DEER Measure IDs are D03-099 (PTAC) and ID D03-101 (PTHP).

Building Type. The DEER 2005 database provided data on Packaged Terminal Air Conditioners and Heat Pumps 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 Multi-family (Common Area) and Single Family building type. 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

Eligible Building Type	DEER Building Type
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, 7-15kBtuh, and >15kBtuh. 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. All Normal Replacement (NR) savings and New Construction (NC) PTHP savings were taken directly from DEER. However, the NEW PTAC savings were based on scaled DEER data. For NEW PTAC, the DEER savings were scaled down based on the more stringent 2019 Title 24 new construction EER requirements (see Code Requirements). Further, the scaling was estimated via building energy simulation using "Lodging" building type and CZ2010 weather, based on the difference in savings between the 2019 Title 24 Standards and the DEER Standard Case. Based on this analysis, the NEW PTAC DEER data was scaled down 6.7% and 13.3% on energy (kWh) and demand (kW) savings respectively.²

PEAK ELECTRIC DEMAND REDUCTION (KW)

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

Scaled DEER peak kW savings for 2020 Update. In order to account for the changing peak period from to meet the requirements of Draft Resolution E-4952, a scaling factor has been applied to all peak kW

² Refer to the SWHC027-02 MeasureDataSpec - PTAC and PTHP under 24 kBtuh, under the DEER Scaler tab for additional details.

savings taken directly from DEER. Savings have been scaled on based on a prototypical model simulation run for each climate zone using eQUEST 3.65 build 7175. The most appropriate prototype model available was pulled from MAScontrol2 for a multifamily (MFm) building type. CZ2010 data was used to perform a model simulation for all 16 climate zones. To calculate the appropriate scaling factor kW was calculated for the previous DEER peak period definition (3 consecutive, non-holiday weekdays, 2PM to 5PM) and for the new DEER peak period definition (3 consecutive, non-holiday weekdays, 4PM to 9PM). Two scenarios were modeled for each climate zone, one for PTAC/PTHP between 7 and 15 kBtuh and one for PTAC/PTHP greater than 15 kBtuh. The difference in the DEER peak shift between the two cases was minimal, however a weighted average was used to determine the final scaling factor in the table below.

Climate Zone	DEER Peak Scaling Factor
CTZ01	68%
CTZ02	-5%
CTZ03	5%
CTZ04	-17%
CTZ05	4%
CTZ06	-29%
CTZ07	-34%
CTZ08	-37%
CTZ09	-33%
CTZ10	-34%
CTZ11	29%
CTZ12	26%
CTZ13	17%
CTZ14	-16%
CTZ15	-1%
CTZ16	37%

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 (PTHP) are presented below. Note that RUL is only applicable for add on equipment (AOE) and accelerated replacement (AR) measures thus not applicable for this measure.

Effective Useful Life and Remaining Useful Life

Parameter	Value	Source
EUL (yrs)	15.0	READi v2.5.1 EUL Table
RUL (yrs)	n/a	n/a

BASE CASE MATERIAL COST (\$/UNIT)

The base case costs were taken from DEER2008 and validated utilizing online retailers in Q4 2020. Links to the researched online retailer prices are embedded in the Online Retailer spot check tab of workbook³. Online retailer spot checks were performed and found the pricing to, on average, 14% (PTACs) 6% (PTHPs) lower than the DEER2008 costs. For the base case one PTAC and one PTHP cost source was used to estimate cost differences. Based on these findings, the DEER2008 costs were adjusted based on the price percent difference and were utilized for this work paper, please see Costs documentation (Attachment 3) for additional details.

The cost of a standard PTAC was determined by using the DEER cost case ID PTAC-7to15kBtuh-10p16eer, and then applying the climate zone cost factor from table HVAC50 (DEER READI Tool 2.5.1). The cost of a standard PTHP was determined by using the DEER cost case IDs PTHP-7to15kBtuh-9p96eer-2p91cop.

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

Base Case Material Cost

Base Case	DEER Cost Case ID	Base Case - Code/Standard Material Cost (DEER2008)	Base Case -Code/ Standard Material Cost (2020 Online Retailer)	Percent difference (DEER2008 vs. 2020 Online Retailer)
Standard Package Terminal Air Conditioner DX Equipment	PTAC-7to15kBtuh-10p16eer	\$1,061.00	\$907.20	-14%
Standard Package Terminal Heat Pump DX Equipment	PTHP-7to15kBtuh-9p96eer-2p91cop	\$1,104.00	\$1,035.72	-6%

MEASURE CASE MATERIAL COST (\$/UNIT)

The measure case costs were taken from DEER2008 and were validated utilizing online retailers as a part of this update. Links to the researched online retailer prices are embedded in the Online Retailer spot check tab of workbook.⁴ Online retailer spot checks were performed and found the pricing to be under

³ Please refer to SWHC027-02 MeasureDataSpec - PTAC and PTHP under 24 kBtuh "Cost Data" tab for more details.

⁴ Please refer to SWHC027-02 MeasureDataSpec - PTAC and PTHP under 24 kBtuh "Cost Data" tab for more details.

7% difference from the DEER2008 costs for PTACs and PTHPs. For the measure case, three PTAC and three PTHP cost sources were used to estimate cost differences. Based on these findings, the DEER2008 costs were found to be reasonable and were utilized for this work paper, please see Costs documentation (Attachment 3) for additional details. The cost of a high efficiency PTAC was determined by using the cost case ID PTAC-7to15kBtuh-12p19eer, and then applying the climate zone cost factor from table HVAC50 (DEER READI Tool 2.5.1. The cost of a high efficiency PTHP was determined by using the cost case ID PTHP-7to15kBtuh-11p95eer-3p49cop. The measure costs for the new construction installation type have been set equal to normal replacement for simplicity, while acknowledging there are differences in costs between the different efficiency units, the incremental costs would be approximately the same and is acceptable.

Measure Material Cost

Measure Case	DEER Cost Case ID	Measure Material Cost (DEER2008)	Measure Material Cost (2020 Online Retailer)	Percent difference (DEER2008 vs. 2020 Online Retailer)
High Efficiency Package Terminal Air Conditioner DX Equipment	PTAC-7to15kBtuh-12p19eer	\$1,105.00	\$1,029.96	-7%
High Efficiency Package Terminal Heat Pump DX Equipment	PTHP-7to15kBtuh-11p95eer-3p49cop	\$1,239.00	\$1,157.40	-7%

BASE CASE LABOR COST (\$/UNIT)

The labor hours used for measure case installations were adopted from DEER2008. However, the labor rates used to estimate total labor dollars were updated from the 2010-2012 WO017 Ex Ante Measure Cost Study Final Report⁵, for the labor rate associated with small packaged heat pump installation.⁶ RS Means 2011 and RS Means 2020 were used to determine the average labor rate increase to install a small packaged terminal unit. Labor rates were increased by 21% based on this analysis. As a result, the labor rate has been adjusted from \$70.78 per hour to \$85.72 per hour. Installation hours for the base case is estimated as 6.82 hours to determine total labor cost.

MEASURE CASE LABOR COST (\$/UNIT)

The labor hours used for measure case installations were adopted from DEER2008. However, the labor rates used to estimate total labor dollars were updated from the 2010-2012 WO017 Ex Ante Measure

⁵ WO017 citation Section 4, Table 4-3, of

⁶ Please refer to SWHC027-02 MeasureDataSpec - PTAC and PTHP under 24 kBtuh "Cost Data" tab for more details.

Cost Study Final Report⁷, for the labor rate associated with small packaged heat pump installation.⁸ RS Means 2011 and RS Means 2020 were used to determine the average labor rate increase to install a small packaged terminal unit. Labor rates were increased by 21% based on this analysis. As a result, the labor rate has been adjusted from \$70.78 per hour to \$85.72 per hour. Installation hours for the base case is estimated as 6.82 hours to determine total 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	

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. The assigned GSIA value for this measure is specified below. 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.

⁷ WO017 citation Section 4, Table 4-3, of

⁸ Please refer to SWHC027-02 MeasureDataSpec - PTAC and PTHP under 24 kBtuh “Cost Data” tab for more details.

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.

Table 2. 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	ExAnte 2022
Reason for Deviation from DEER	Given assessment of program participation, the 7 kBtuh to 15 kBtuh equipment capacity measures were used for this work paper. Additionally, DEER savings were scaled down for 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>VAC-PTAC HVAC-PTHP, HV-ResAC, HV-ResHP</i>

REVISION HISTORY

Table 3. Measure Characterization Revision History

Revision Number	Date	Primary Author, Title, Organization	Revision Summary and Rationale for Revision Effective Date and Approved By
01	06/30/2018	Jennifer Holmes Cal TF Staff	Draft of consolidated text for this statewide measure is based upon: SCEHC007, Revision 0 (December 14, 2016) PGECHVC114, 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.
	08/11/2021	Soe K Hla PG&E	Adopted all measures for PG&E Fixed incorrect BldgType and IETableName in EAD
02	11/22/2020	Joseph Ling/AESC	Recalculate models used for DEER Peak scaling factors. Update costs.
	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.
	11/15/2021	Ajay Wadhwa/SCE	Corrected SFm and WRf building type savings. Savings were swapped incorrectly. Matched eTRM published and corrected data in EAD and DataSpec Tables.
	11/19/2021	Soe K Hla PG&E	Included PG&E adopted measures and corrected IETableName in EAD from rev. 01. Switched incorrect material cost for measure cases in EAD.