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## HVAC

### SWSV007-01 CONDENSER COIL CLEANING, RESIDENTIAL

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**MEASURE NAME**

Condenser Coil Cleaning, Residential

**STATEWIDE MEASURE ID**

SWSV007-01

**TECHNOLOGY SUMMARY**

Proper maintenance of an air conditioner (AC) or heat pump HVAC equipment will enable the equipment to operate at or near its optimal efficiency. Quality maintenance (QM) measures are treatments designed to increase the effectiveness of HVAC equipment to deliver heating and cooling and increased thermal comfort.

The level of maintenance by technicians on a typical AC or heat pump unit is minimal with service being performed at an unacceptable level. This may eventually lead to unit failure and/or poor performance, forcing premature equipment replacement. In response to this problem, Air Conditioner Contractors of America (ACCA) developed Standard 4 for “Maintenance of Residential HVAC Systems”.<sup>1</sup>

The impact evaluation of 2015 commercial quality maintenance programs (HVAC3) conducted by DNV GL<sup>2</sup> analyzed the impacts of three residential measures implemented through the QM programs: coil cleaning, supply fan, and refrigerant charge adjustment – RCA (as well the five commercial measures with the highest claimed savings across the QM programs). The specific programs evaluated were Residential QM (PG&E, SDG&E), Commercial QM (PG&E), AirCare Plus (PG&E), QM (SCE and SoCalGas), Deemed (SDG&E), and Direct Install (SDG&E).

**MEASURE CASE DESCRIPTION**

This measure is defined as cleaning of HVAC condenser coils to increase the unit’s ability to deliver heating and cooling efficiently and to provide increased thermal comfort.

**BASE CASE DESCRIPTION**

The base case for this measure is defined as a standard non-treated HVAC system.

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<sup>1</sup> Air Conditioning Contractors of America (ACCA). 2013. *Maintenance of Residential HVAC Systems*. ANSI/ACCA Standard 4 QM – 2013.

<sup>2</sup> DNV GL. 2017. *Impact Evaluation of 2015 Commercial Quality Maintenance Programs (HVAC3)*. Prepared for the California Public Utilities Commission. April 7.

## CODE REQUIREMENTS

This measure is not governed by federal or state appliance or building standards. The California Building Energy Efficiency Standards (Title 24) does not deal with quality maintenance (QM) treatments. Notably, the California mechanical code states that changes, alterations, or repairs of a minor nature that do *not* affect structural features, egress, sanitation, safety, or accessibility as determined by the enforcing agency are exempt from the requirement to obtain a mechanical permit.

Note, however, the program requires the HVAC contractor to be licensed by the California State Licensing Board (CSLB) and that HVAC technicians are certified by the U.S. Environmental Protection Agency (EPA).

### Applicable State and Federal Codes and Standards

Code	Applicable Code Reference	Effective Date
CA Appliance Efficiency Regulations – Title 20 (2019)	None	1/1/2019
CA Building Energy Efficiency Standards – Title 24 (2019)	None	1/1/2020
Federal Standards	None	n/a

## NORMALIZING UNIT

Tons of cooling capacity (Cap-Tons)

## PROGRAM REQUIREMENTS

### Measure Implementation Eligibility

All measure application type, delivery type, and sector combinations 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.

### Implementation Eligibility

Measure Application Type	Delivery Type	Sector
BRO-RCx	Direct Install	Res
BRO-RCx	Down-Stream Incentive	Res
BRO-RCx	Up-Stream Incentive	Res

Note: Up-Stream Incentive is being left as an approved Delivery Type to enable Midstream offerings.

### Eligible Products

The following prerequisites must be met before the Quality Maintenance (QM) treatments, such as condenser coil cleaning, can be implemented:

- The unit and system must be capable of delivering a supply air flow rate of at least 350 cfm/ton after treatments related to air flow are completed and before refrigerant charge is tested and/or adjusted.
- The unit must be drawing power.

- The unit must have a condenser over ambient temperature (COAT) of at least 3 degrees.
- An assessment and report are required in accordance with ACCA Standard 4<sup>3</sup> prior to any treatments being applied to determine the baseline conditions and to develop QM treatment recommendations.
- The customer must agree to a QM Service Agreement.

#### *Eligible Building Types and Vintages*

This measure is applicable for residential single family, multifamily, and double-wide mobile homes that use central air-cooled direct expansion (DX) cooling and gas heating.

#### *Eligible Climate Zones*

This measure is applicable in all California climate zones.

### PROGRAM EXCLUSIONS

None.

### DATA COLLECTION REQUIREMENTS

Data requirements are to be determined.

### USE CATEGORY

HVAC

### ELECTRIC SAVINGS (kWh)

The electric unit energy savings (UES) of condenser coil cleaning of residential air conditioning (AC) units were derived from impacts in the Database of Energy Efficient Resources (DEER). The DEER version used to calculate savings for these measures is DEER 2020. The results were reported in the Remote Ex-Ante Database Interface (READI) tool v2.5.1.

The UES of this coil cleaning measure were derived as a function of the refrigerant charge adjustment (RCA) measure in DEER2020 (Measure ID: *Res-RefrigCharge-wtd*),<sup>4</sup> (See “ResCondCoilCleaning” tab.) in

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<sup>3</sup> Air Conditioning Contractors of America (ACCA). 2013. *Maintenance of Residential HVAC Systems*. ANSI/ACCA Standard 4 QM – 2013.

<sup>4</sup> California Public Utilities Commission (CPUC), Energy Division. 2013. “20132014-ResidentialHVACMaintenance-SavingsValues-April2013-v1-2.xlsx”

conformance with the “Workpaper Disposition for Residential HVAC Quality Maintenance” issued by the California Public Utilities Commission (CPUC) Energy Division in May 2013 (May 2013 RQM Disposition).<sup>5</sup>

The derivation of the UES of the RCA measure ( $UES_{Res-RefrigCharge-Wtd}$ ) and the adjustment to derive the coil cleaning UES is documented in the May 2013 RQM Disposition.<sup>5</sup>

$$UES_{cond\ coil\ cleaning} = UES_{Res-RefrigCharge-Wtd} \times 0.125$$

The adjustment factor of 0.125 is based upon the following assumptions:

1. QM treatments related to RCA include a refrigerant charge adjustment as well as “non-charge” related measures. Non-charge measures include condenser coil cleaning, evaporator coil cleaning, and air flow adjustment.
2. Energy Division staff estimated that non-charge measures “may account for an additional 25% savings on top of RCA” (page 6). Thus, the total impacts associated with all non-charge measures is:

$$UES_{Total\ Non-charge} = UES_{Res-RefrigCharge-Wtd} \times 0.25$$

3. Because of the lack of quantified evidence of the impacts of the non-charge measures, the Energy Division stipulated the distribution of the total non-charge measure savings across the three non-charge measures shown in the chart below<sup>6</sup>.

Percent of Total Non-charge Impacts (%)



**Condenser Coil Cleaning = 50%, Evaporator Coil Cleaning = 25%, Air Flow Adjustment = 25%**

4. The UES of the condenser coil cleaning measure is therefore calculated as 50% of the total non-charge impacts:

<sup>5</sup> California Public Utilities Commission (CPUC), Energy Division, Ex Ante Review Team. 2013. “Workpaper Disposition for Residential HVAC Quality Maintenance.” May 2.

<sup>6</sup> California Public Utilities Commission (CPUC), Energy Division, Ex Ante Review Team. 2013. “Workpaper Disposition for Residential HVAC Quality Maintenance.” May 2. Page 7.

$$UES_{cond\ coil\ cleaning} = UES_{Total\ Non-charge} \times 0.50$$

$$UES_{cond\ coil\ cleaning} = UES_{Res-Refrigerant-Charge-Wtd} \times 0.25 \times 0.50$$

$$UES_{cond\ coil\ cleaning} = UES_{Res-Refrigerant-Charge-Wtd} \times 0.125$$

## PEAK ELECTRIC DEMAND REDUCTION (kW)

See Electric Savings.

## GAS SAVINGS (THERMS)

See Electric Savings.

## 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.

As per Resolution-4952<sup>7</sup> and Resolution-5009<sup>8</sup>, the California Public Utilities Commission (CPUC) created the Behavioral Operational Retrocommissioning (BRO-RCx) measure classification which provides corrected EUL and RUL values shown below.

### Effective Useful Life and Remaining Useful Life

Parameter	Value	Source
EUL (yrs) (HV-ResAC-CleanCoil)	3	California Public Utilities Commission (CPUC), Energy Division. 2018. <i>DEER resolution E-4952</i> . 11 October 2018
RUL (yrs)	0	California Public Utilities Commission (CPUC), Energy Division. 2019. <i>DEER resolution E-5009</i> . 12 September 2019

## BASE CASE MATERIAL COST (\$/UNIT)

The base case is defined as the existing equipment; thus, the base case material cost is \$0.00.

<sup>7</sup> California Public Utilities Commission (CPUC), Energy Division. 2018. *DEER resolution E-4952*. 11 October 2018

<sup>8</sup> California Public Utilities Commission (CPUC), Energy Division. 2019. *Draft DEER resolution E-5009*. 15 August 2019

### MEASURE CASE MATERIAL COST (\$/UNIT)

The measure case material and labor cost for condenser coil cleaning adjustments were drawn from 2010-2012 WO017 Ex-Ante Measure Cost Study conducted by Itron, Inc.<sup>9</sup> This study reports costs for a “typical” coil cleaning measure.

The cost data were scaled to 2018 cost values using an average of all 12 California cities in the 2018 RS Means Historical Cost Indexes table<sup>10</sup>. The RSMeans Historical Cost Index can be used to compare costs of projects between different cities and years. The ratio of cost indexes provides the percent change expected in the price between the specified years. A comparison of the cost indexes for 2012 and 2018 for the average of 12 California cities in the 2018 (209.3 and 239.9, respectively) reveals a cost increase of 14.6%. This percentage increase value was applied to the WO017 data to reflect 2018 costs.

Inputs to develop the measure case material costs are specified below.

#### Measure Case Material and Labor Cost Inputs

Input	Value	Source
Condenser cleaning material cost (\$/ton)	\$7.71	Itron, Inc. 2014. <i>2010-2012 WO017 Ex Ante Measure Cost Study Final Report</i> . Prepared for the California Public Utilities Commission.
Condenser cleaning labor cost (\$/ton)	\$29.41	
Price index adjustment (%)	14.6%	RSMeans Historical Cost Index <a href="https://www.rsmeansonline.com/references/unit/refpdf/hci.pdf">https://www.rsmeansonline.com/references/unit/refpdf/hci.pdf</a> “RSMeans Cost Index.pdf”

### BASE CASE LABOR COST (\$/UNIT)

The base case is defined as the existing equipment; thus, the base case labor cost is \$0.00.

### MEASURE CASE LABOR COST (\$/UNIT)

See Measure Case Material 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 default NTG value is based upon the average of all NTG ratios for all evaluated 2006 – 2008 residential programs, as documented in the 2011 DEER Update Study conducted by Itron, Inc. This sector average NTG (“default NTG”) is applicable to all energy

<sup>9</sup> Itron, Inc. 2014. *2010-2012 WO017 Ex Ante Measure Cost Study Final Report*. Prepared for the California Public Utilities Commission.

<sup>10</sup> RSMeans Historical Cost Index <https://www.rsmeansonline.com/References/CCI/3-Historical%20Cost%20Indexes/3-Historical%20Cost%20Indexes.PDF>

efficiency measures that have been offered through residential sector programs for more than two years and for which impact evaluation results are not available.

#### Net-to-Gross Ratios

Parameter	Value	Source
Res-Default>2	0.55	California Public Utilities Commission (CPUC), Energy Division. 2018. <i>DEER resolution E-4952</i> . 11 October 2018. Table 7

#### GROSS SAVINGS INSTALLATION ADJUSTMENT (GSIA)

The gross savings installation adjustment (GSIA) rate 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. The specified GSIA is in conformance to the installation rate specified by the California Public Utilities Commission (CPUC) Energy Division in the “Workpaper Disposition for Residential HVAC Quality Maintenance” issued in May 2013.

#### Gross Savings Installation Adjustment Rates

Parameter	Value	Source
GSIA – Default value	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 2020 contains quality maintenance (QM) treatments as standalone measures, with the assumption that all other features of the prototype are held constant at an energy efficient baseline; the standalone measures are: refrigerant charge and adjustment, duct sealing, refrigerant charge with duct sealing, and condenser coil cleaning. All measure impacts are derived from DEER2020 and CPUC disposition<sup>11</sup> (e.g., Coil cleaning treatments).

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<sup>11</sup> California Public Utilities Commission (CPUC), Energy Division, Ex Ante Review Team. 2013. “Workpaper Disposition for Residential HVAC Quality Maintenance.” May 2.

## DEER Difference Summary

DEER Item	Comment / Used for Workpaper
Modified DEER methodology	Yes (as noted)
Scaled DEER measure	Yes – impacts of coil cleaning measure based upon scaled refrigerant charge measure impacts
DEER Base Case	Yes
DEER Measure Case	Yes
DEER Building Types	Yes
DEER Operating Hours	Yes
DEER eQUEST Prototypes	No
DEER Version	DEER 2020 per READI v2.5.1
Reason for Deviation from DEER	Disposition to DEER and Resolution E-4952
DEER Measure IDs Used	Res-RefrigCharge-wtd
NTG	Source: DEER. The NTG of 0.55 is associated with NTG ID: <i>Res-Default&gt;2</i>
GSIA	Source: DEER. The GSIA of 1.0 is associated with GSIA ID: <i>Def-GSIA</i>
EUL/RUL	Source: 2018 Resolution E-4952. EUL values of one to three years with retrocommissioning assigned a three-year EUL. EUL and RUL values are corrected based on Table 8 in E-4952. The value of 3 years is associated with EUL ID: <i>HV-ResAC-CleanCoil</i> . 2019 Resolution E-5009. RUL value for BRO measures corrected to 0 years.

## REVISION HISTORY

## Measure Characterization Revision History

Revision Number	Date	Primary Author, Title, Organization	Revision Summary and Rationale for Revision Effective Date and Approved By
01	09/30/2018	Jennifer Holmes Cal TF Staff	Draft of consolidated text for this statewide measure is based upon: SCE17HC029, Revision 1 (May 22, 2018) WPSDGERERN001, Revision 3 (December 15, 2017) – short form WPSDGERERN001, Revision 0.1 (July 27, 2014) Consensus reached among Cal TF members.
01	04/23/2019	Richard Williams TRC Companies	Updated Implementation Eligibility Table Updated NTG ID value and cost adjustment Updated RUL values based on E-5009
01	09/17/2019	Richard Williams TRC Companies	Updated document to reflect DEER 2020 and energy impact savings updates resulting from a new weighting methodology.