Short Form Work Paper WPSDGEREHC0032

**Revision 0**

**San Diego Gas & Electric**

**Energy Efficiency Engineering**

**Refrigerant Charge Adjustment**

**December 22, 2017**

# SDG&E Refrigerant Charge Adjustment

## Introduction

This short form workpaper documents the values from the READI v.2.4.7 energy impacts for Res-RefrigCharge-wtd and Res-RCA-wtd. SDG&E adopts the values in READI v2.4.7 with adjustment factors from Energy Division Workpaper Disposition for Residential HVAC Quality Maintenance dated May 2, 2013[[1]](#endnote-1). The costs are adopted from 2010-2012 WO17 Ex Ante Measure Cost Study[[2]](#endnote-2).

## Document Revision History

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| --- | --- | --- | --- |
| **Rev** | **Date** | **Author** | **Summary of Changes** |
| 0 | 12/22/17 | Keith Valenzuela/SDGE Contractor | Adopted READI v.2.4.7 energy impacts for DEER 2018 updates with adjustment factors from Energy Division Workpaper Disposition for Residential HVAC Quality Maintenance dated May 2, 2013. |
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## Measure Summary

Table 1: Measure Summary Table

| **Section** | **Value** |
| --- | --- |
| **Summary & Purpose** | This short form workpaper documents ex-ante load impacts and cost-effectiveness values for only adjusting the refrigerant charge in residential AC units or refrigerant charge and airflow adjustment residential AC units. The base energy consumption and measure energy consumption values are from READI v.2.4.7.  This short form workpaper details the energy impacts of adjusting the refrigerant charge from the existing charge which does not meet manufactures specifications to the manufactures specifications or adjusting the refrigerant charge and airflow from the existing conditions which do not meet manufactures specifications to the manufactures specifications. |
| **1.1 Measure & Baseline Data** | |
| **1.2 Technical Description** | This measure involves refrigerant charge adjustment to residential AC units or refrigerant charge and airflow adjustment to residential AC units. When an AC unit’s refrigerant charge and airflow does not meet the manufacturer recommended levels it results in a decrease in the unit’s energy efficiency.  Some units may be undercharged, which can result in decreased power draw but potentially longer run times. Other units may be overcharged, which can result in increased power draw but potentially shorter run times. In either case, energy savings can be achieved by correcting refrigerant charge to optimum levels based on the manufacturers’ specifications. |
| Measures | Measure 1:  462344 – Adjust refrigerant charge in residential AC unit  Measure 2:  420090 – Residential refrigerant charge and airflow adjustment  Measure 3:  421026 – AC Diagnostic, Repair and Tune-up 1995-2005  Measure 4:  420147 – Airflow Correction |
| Code for All Measures | There are no energy efficiency standards or energy design standards for this measure.  The measure involves only residential retrofit, therefore, 2016 Title-24 code for non-residential efficiency requirements do not apply to this work paper.  2016 Title 20 does not address the charge, coil condition or airflow of the AC unit as it is a code for new equipment it is assumed the AC unit is installed with the manufacturer recommended refrigerant levels, clean coils and airflow. |
| Requirements | Per the SDG&E Quality Assurance and Quality Control Plan (QAQCP) technicians must receive training as follows:  **“**New technicians receive individual classroom training from the production supervisor and on-the-job training by serving as a helper from a certified trainer.  All technicians receive electrical training and follow safe electrical protocols, standards and practices.  The contractor regularly enrolls its technicians in technical training.  All technicians are required to attend a weekly tailgate meeting, plus a monthly technicians meeting for on-going training. The type of information that is covered in these training sessions would include measure and service standards, review of safety standards, motivation, customer service, and quality control instruction.  The production supervisor or assistant production manager also provides one-on-one training to technicians in the field.”  In addition, the airflow must meet ACCA 4 Standard minimum requirements. |
| **1.3 Installation Type and Delivery Mechanisms** | |
| Installation Type | Retrofit Add-on (REA) |
| Delivery Mechanisms | Direct Install |
| **1.4.1 DEER Data** | |
| Net-to-Gross Ratio | Res-sAll-mHVAC-RCA |
| Effective and Remaining Useful Life | HVAC-RefChg  EUL= 10 years  RUL=EUL/3=3.3 |
| GSIA | Per Energy Division Workpaper Disposition for Residential HVAC Quality Maintenance dated May 2, 2013  GSIA ID: Res-RCA-All |
| **Section 2. Calculation Methodology** | |
| Energy Savings/Peak Demand Reduction – All Measures | The annual energy and demand savings for the residential sector are based on the DEER measure savings from Res-RefrigCharge-wtd, taken from the DEER 2018 READI v.2.4.7. The READI v.2.4.7 values are adjusted based on Energy Division Workpaper Disposition for Residential HVAC Quality Maintenance dated May 2, 2013.  From Workpaper Disposition:  “Based on the data collected, 45% of all serviced units had charge adjustments less than 10%. No significant energy savings related to charge adjustment occurs for those units. From this, when the level of charge adjustment is ignored, the charge adjustment savings (based on values in the 2011 DEER) must be reduced by the number of units for which no significant savings are expected. In consideration of values from Figure 1 as well as the possibility that some refrigerant charge adjustments may result in increased energy use, staff has assigned an incidence fraction of 0.40 to savings values for RCA.”  “Staff estimate that non-charge related services may account for an additional 25% savings on top of RCA. Based on this assessment, published DEER benefits are segregated into charge adjustment and non-charge adjustment remedies as follows:  Gross Charge Adjustment Savings = DEER values  Gross Non-Charge Adjustment Savings = DEER values \* 0.25“    Measure 1:  462344 – Adjust refrigerant charge in residential AC unit  Workpaper Savings = DEER values \* 0.40    The annual energy and demand savings for the residential sector are based on adjusted DEER measure savings from Res-RCA-wtd. The READI v.2.4.7 values are adjusted based on Energy Division Workpaper Disposition for Residential HVAC Quality Maintenance dated May 2, 2013.  From Workpaper Disposition:  **Non-Charge Adjustment Savings Modifiers:**  There is no known evidence as to the relative impact from the three measures – condenser coil cleaning, evaporator coil cleaning and air flow adjustment - that generate non-charge adjustment savings. It is generally recognized that typical efficiency improvements associated with condenser coil cleaning is much larger than the other two. Given a paucity of direct measurements of field conditions, Commission staff recommends the following apportioning of non-charge adjustment savings among the three possible measures:  Condenser Coil Cleaning: 50% of the total  Evaporator Coil Cleaning: 25% of the total  Air Flow Adjustment: 25% of the total.”  In addition to these adjustments the disposition states savings were adjusted by incidence fractions.  From Workpaper Disposition:  “In addition to the fractions described above, staff also assigns the following incidence fractions to the gross savings results:  Condenser Coil Cleaning: 0.80  Evaporator Coil Cleaning: 0.60  Air Flow Adjustment: 0.60”  Measure 2:  420090 – Residential refrigerant charge and airflow adjustment  Workpaper Savings = (DEER values\*0.40) + (DEER values \* 0.25\*0.25\*0.60)    Measure 3:  421026 – AC Diagnostic, Repair and Tune-up 1995-2005  The measure includes refrigerant charge, airflow adjustment and coil cleaning.  Workpaper Savings = (DEER values\*0.40) + (DEER values \* 0.25\*0.25\*0.60) + (DEER values \* 0.25\*0.50\*0.80)    Measure 4:  420147 – Airflow Correction  The measure includes an airflow adjustment.  Workpaper Savings = (DEER values \* 0.25\*0.25\*0.60) |
| **Section 3. Load Shapes** | |
| Load Shape | SDGE:DEER:HVAC\_Eff\_AC Annual |
| **Section 4. Cost** | |
| **Section 4.1 Base and Measure Costs** | |
| Base Cost | The base case is the customer’s existing equipment; therefore, the base case cost is $0.00. |
| Measure Cost | The 2010-2012 WO17 Ex Ante Measure Cost Study provides refrigerant charge adjustment and coil cleaning per-ton costs by leveraging a sample size of ten direct install (DI) primary price data points from utilities over the past two program cycles (2010-2012 and 2013-2014). The study does not address airflow adjustment, it is assumed the airflow adjustment cost is minimal and therefore the cost of refrigerant charge adjustment includes the cost of a refrigerant charge adjustment and airflow adjustment.  Measure 1:  $36.70/ton (See Measure 2) - $1.38/ton (See Measure 4) = 35.32/ton.  Measure 2:  The study provides costs per ton cooling for RCA of $9.92 for materials and $26.78 for labor for a total cost of $36.70/ton.  Measure 3:  The study provides costs per ton cooling for refrigerant charge of $9.92 for materials and $26.78 for labor for a cost of $36.70/ton.The study provides costs per ton cooling for coil cleaning of $6.73 for materials and $25.65 for labor for a cost of $32.38/ton. The total cost is $69.08/ton.  Measure 4:  Since it is assumed the cost of the airflow adjustment is included in the RCA cost, the same methodology used to estimate airflow adjustment savings based on RCA saving will be used to determine the cost.  Airflow cost = (RCA cost \* 0.25\*0.25\*0.60)  Airflow cost = ($36.70/ton \* 0.25 \* 0.25\* 0.60) = $1.38/ton |

1. California Public Utilities Commission, Energy Division. Workpaper Disposition for

   Residential HVAC Quality Maintenance. Sacramento, CA (2013, May 2). Retrieved 12/1/17 at <http://deeresources.com/index.php/non-deer-workpapers>. [↑](#endnote-ref-1)
2. Itron. 2010-2012 WO017 Ex Ante Measure Cost Study Final Report. San Francisco, CA (2014, May 27). Retrieved 11/14/17 at <http://www.energydataweb.com/cpucFiles/pdaDocs/1100/2010-2012%20WO017%20Ex%20Ante%20Measure%20Cost%20Study%20-%20Final%20Report.pdf>. [↑](#endnote-ref-2)