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**BUILDING ENVELOPE**  
**RESIDENTIAL CEILING INSULATION**  
SWBE006-01

**C O N T E N T S**

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## MEASURE NAME

Residential Ceiling Insulation

## STATEWIDE MEASURE ID

SWBE006-01

## TECHNOLOGY SUMMARY

This residential ceiling insulation measure involves installing insulation to the attic or knee walls of a home. Installing insulation creates a better barrier between the conditioned space of the home and outside or unconditioned spaces. This will save energy by reducing the heating or cooling required to make up for lost heating and cooling.

## MEASURE CASE DESCRIPTION

The measure case is defined as Residential Ceiling Insulation including:

1. Ceiling - Add R-11 batts on top of vintage-specific existing insulation (RB-BS-Ceillns-VintR-AddR11)
2. Ceiling - Add R-19 batts on top of vintage-specific existing insulation (RB-BS-Ceillns-VintR-AddR19)
3. Ceiling - Add R-30 batts on top of vintage-specific existing insulation (RB-BS-Ceillns-VintR-AddR30)
4. Ceiling - Add R-38 batts on top of vintage-specific existing insulation (RB-BS-Ceillns-VintR-AddR38)

## Historical Background

The residential ceiling insulation measure is a measure that was originally identified in the DEER 2005 database with DEER Measure IDs: D03-420 – D03-424. The residential ceiling insulation measure was divided into two categories including:

1. Addition of R-30 or R-38 to an uninsulated attic/ceiling.
2. Increasing vintage insulation level to R-30, R-38 or R-49.

In 2017, SDG&E created an Attic Insulation short form workpaper (WPSDGEREHC1066, Revision 0) adopting the energy impact values from the DEER 2017 (READI v.2.4.7) database including:

1. RB-BS-Ceillns-VintR-AddR19 and
2. RB-BS-Ceillns-VintR-AddR11 and RB-BS-Ceillns-R0-R38.

Despite using many of the DEER READi cost-effectiveness parameters to support any residential ceiling insulation claims, the DEER READi tool does not support all cost-effectiveness parameters required for ex-ante data reporting requirements. Thus, SDG&E created a short form workpaper to allow for compliant reporting and claims requirements.

Since there are differences between DEER (Ceiling Insulation) and workpaper naming (Attic Insulation), the measure naming for this statewide workpaper is known as Residential Ceiling Insulation to ensure consistency and avoid the potential confusion in regulatory compliance reporting and claims.

## BASE CASE DESCRIPTION

The base case is defined as the customer's existing insulation, if any.

## CODE REQUIREMENTS

### Title 24 2019 Building Energy Efficiency Standards for Residential and Nonresidential Buildings

SECTION 110.8 (d) Installation of Insulation in Existing Buildings. Insulation installed in an existing attic, or on an existing duct or water heater, shall comply with the applicable requirements of Subsections 1, 2, and 3 below. If a contractor installs the insulation, the contractor shall certify to the customer, in writing, that the insulation meets the applicable requirements of Subsections 1, 2, and 3 below.

1. **Attics.** If insulation is installed in the existing attic of a low-rise residential building, the R-value of the total amount of insulation (after addition of insulation to the amount, if any, already in the attic) shall meet the requirements of Section 150.0(a).

**EXCEPTION to Section 110.8(d)1:** Where the accessible space in the attic is not large enough to accommodate the required R-value, the entire accessible space shall be filled with insulation provided such installation does not violate Section 1203.2 of Title 24, Part 2”

**“SECTION 150.0 (a) Ceiling and Rafter Roof Insulation.** The opaque portions of ceilings and roofs separating conditioned spaces from unconditioned spaces or ambient air shall meet the requirements of Items 1 through 3 below:

1. Shall be insulated to achieve a weighted average U-factor not exceeding U-0.043 or shall be insulated between wood-framing members with insulation resulting in an installed thermal resistance of R-22 or greater for the insulation alone. For vented attics, the mandatory insulation shall be installed at the ceiling level; for unvented attics, the mandatory insulation shall be placed at either ceiling or roof level; and

**EXCEPTION to Section 150.0(a)1:** Ceilings and rafter roofs in an alteration shall be insulated to achieve a weighted average U-factor not exceeding 0.054 or shall be insulated between wood-framing members with insulation resulting in an installed thermal resistance of R-19 or greater.

2. Attic access doors shall have permanently attached insulation using adhesive or mechanical fasteners. The attic access shall be gasketed to prevent air leakage; and
3. Insulation shall be installed in direct contact with a continuous roof or ceiling which is sealed to limit infiltration and exfiltration as specified in Section 110.7, including but not limited to placing insulation either above or below the roof deck or on top of a drywall ceiling.”

#### Applicable State and Federal Codes and Standards

Code	Applicable Code Reference	Effective Date
CA Appliance Efficiency Regulations – Title 20	N/A	N/A
CA Building Energy Efficiency Standards – Title 24	Title 24	1/1/2020
Federal Standards	N/A	N/A

## NORMALIZING UNIT

Area-ft<sup>2</sup>

## PROGRAM 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.”

### 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
Add-On Equipment (AOE)	DnDeemed	Residential
Add-On Equipment (AOE)	UpDeemed	Residential
Add-On Equipment (AOE)	DnDeemDI	Residential

### Eligible Products

N/A.

### Eligible Building Types and Vintages

This measure is applicable in all vintages in all residential single-family, multi-family and double wide mobile home dwelling units with a HVAC system.

### Eligible Climate Zones

This measure is applicable in all California climate zones.

## PROGRAM EXCLUSIONS

N/A.

## DATA COLLECTION REQUIREMENTS

Data collection requirements are to be determined.

## USE CATEGORY

Building Envelope (BldgEnv)

## ELECTRIC SAVINGS (kWh),

### Methodology

The base energy consumption and measure energy consumption values are directly from READI v.2.5.1 for the residential ceiling insulation measures including:

1. Ceiling - Add R-11 batts on top of vintage-specific existing insulation
2. Ceiling - Add R-19 batts on top of vintage-specific existing insulation
3. Ceiling - Add R-30 batts on top of vintage-specific existing insulation
4. Ceiling - Add R-38 batts on top of vintage-specific existing insulation

The applicable Measure IDs and associated Descriptions for the four measures are further broken out in the latest version of the DEER READi as shown in the table below.

MeasureID	Description
<b>RB-BS-Ceillns-VintR-AddR11</b>	Ceiling - Add R-11 batts on top of vintage-specific existing insulation
<b>RB-BS-Ceillns-VintR-AddR19</b>	Ceiling - Add R-19 batts on top of vintage-specific existing insulation
<b>RB-BS-Ceillns-VintR-AddR30</b>	Ceiling - Add R-30 batts on top of vintage-specific existing insulation
<b>RB-BS-Ceillns-VintR-AddR38</b>	Ceiling - Add R-38 batts on top of vintage-specific existing insulation

### Inputs and Assumptions

As described in the 2004-2005 DEER Update Study Report, the residential measures simulated in DEER, contains a top-level description of the methodology used to model each measure for all residential building types. Also included are the primary parameters used in the modeling of each measure and how those parameters are altered from the base case, to the code baseline to the measure; sometimes these parameters vary by climate zone and building vintage. To provide added detail of interest for the measure descriptions links are provided, when appropriate, into MAS tool spreadsheets, and other supporting documents, that contain more details of parameter values. A sample of the assumptions used in the DEER simulation prototypes are shown in the figure below.

<b>Ceiling Vintage to R-30 Insulation-Batts</b>	
ID: <b>D03-422</b>	Abbreviation: <b>RCV30</b>
Measure Description	Ceiling Vintage to R-30 Insulation-Batts
Baseline Characteristics	Per prototype description
Code Baseline Characteristics	Overall ceiling U-factor based on climate zone
Measure Characteristics	Ceiling Vintage to R-30 Insulation-Batts
Savings Reporting Units	1,000 sqft roof
Savings Scalable By	n/a

<b>Ceiling Vintage to R-38 Insulation-Batts</b>	
ID: <b>D03-423</b>	Abbreviation: <b>RCV38</b>
Measure Description	Ceiling Vintage to R-38 Insulation-Batts
Baseline Characteristics	Per prototype description
Code Baseline Characteristics	Overall ceiling U-factor based on climate zone
Measure Characteristics	Ceiling Vintage to R-38 Insulation-Batts
Savings Reporting Units	1,000 sqft roof
Savings Scalable By	n/a

*Electric Load Shapes*

The most applicable measure case load shape for this residential ceiling insulation measure is: DEER: Res\_BldgShell\_Ins. Each program administrator will have its own utility abbreviation at the front of the load shape name. (i.e. SDGE: DEER:Res\_BldgShell\_Ins).

*Gas Load Shapes*

Annual.

**Sample Calculation**

Per the DEER 2004-2005 Update Study Final Report, the overall ceiling U-Factors for the measure, baseline and code baseline are listed in the Residential Roof Insulation Table (ResRoofInsMeasures Sheet of 2005DEERResidentialMeasuresList\_05-08-15.xls).

**PEAK ELECTRIC DEMAND REDUCTION (kW)**

**Methodology**

Based on the latest version of the DEER READi tool (READi v.2.5.1), the peak demand reduction values were exported to the EAD table worksheet attached with this workpaper submission.

## Inputs and Assumptions

As described in the 2004-2005 DEER Update Study Report, the residential measures simulated in DEER, contains a top-level description of the methodology used to model each measure for all residential building types. Also included are the primary parameters used in the modeling of each measure and how those parameters are altered from the base case, to the code baseline to the measure; sometimes these parameters vary by climate zone and building vintage. To provide added detail of interest for the measure descriptions links are provided, when appropriate, into MAS tool spreadsheets, and other supporting documents, that contain more details of parameter values.

## Sample Calculation

Per the DEER 2004-2005 Update Study Final Report<sup>1</sup>, the overall ceiling U-Factors for the measure, baseline and code baseline are listed in the Residential Roof Insulation Table (ResRoofInsMeasures Sheet of 2005DEERResidentialMeasuresList\_05-08-15.xls).

## GAS SAVINGS (Therms)

### Methodology

Similar to the Electric Energy (kWh) section of this workpaper, the base energy consumption and measure energy consumption values are directly from READI v.2.5.1 for the residential ceiling insulation measures including:

1. Ceiling - Add R-11 batts on top of vintage-specific existing insulation
2. Ceiling - Add R-19 batts on top of vintage-specific existing insulation
3. Ceiling - Add R-30 batts on top of vintage-specific existing insulation
4. Ceiling - Add R-38 batts on top of vintage-specific existing insulation

## Inputs and Assumptions

As described in the 2004-2005 DEER Update Study Report, the residential measures simulated in DEER, contains a top-level description of the methodology used to model each measure for all residential building types. Also included are the primary parameters used in the modeling of each measure and how those parameters are altered from the base case, to the code baseline to the measure; sometimes these parameters vary by climate zone and building vintage. To provide added detail of interest for the measure descriptions links are provided, when appropriate, into MAS tool spreadsheets, and other supporting documents, that contain more details of parameter values.

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<sup>1</sup> California Public Utilities Commission (CPUC), Energy Division. 2005. *2004-2005 DEER Update Study Final Report*. Page 8-22.

### Sample Calculation

Per the DEER 2004-2005 Update Study Final Report<sup>1</sup>, the overall ceiling U-Factors for the measure, baseline and code baseline are listed in the Residential Roof Insulation Table (ResRoofInsMeasures Sheet of 2005DEERResidentialMeasuresList\_05-08-15.xls).

### 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 methodology to calculate the RUL conforms with Version 5 of the Energy Efficiency Policy Manual, which recommends “one-third of the effective useful life in DEER as the remaining useful life until further study results are available to establish more accurate values.”<sup>2</sup> This approach provides a reasonable RUL estimate without the requiring any a priori knowledge about the age of the equipment being replaced.<sup>3</sup> Further, as per Resolution E-4807, the California Public Utilities Commission (CPUC) revised add-on measures so that the EUL of the measure is equal to the lower of the RUL of the modified system or equipment or the EUL of the add-on component.”<sup>4</sup>

The EUL and RUL specified below, are based upon the DEER READi Tool version 2.5.1 Support Table. Per

#### Effective Useful Life and Remaining Useful Life

Parameter	Value	Source
EUL (yrs) – measure	20	DEER READi Tool version 2.5.1 Support Table EUL ID: BS-Ceillns
EUL (yrs) – host	20	DEER READi Tool version 2.5.1 Support Table EUL ID: BS-Ceillns
RUL (yrs)	6.7	DEER READi Tool version 2.5.1 Support Table EUL ID: BS-Ceillns

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

The base case is the customer’s existing insulation. Therefore, the base case material cost is \$0.00.

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

The 2010-2012 WO17 Ex Ante Measure Cost Study<sup>5</sup> provides ceiling insulation per-sq. ft. costs. This workpaper adopts the costs from this study.

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<sup>2</sup> California Public Utilities Commission (CPUC), Energy Division. 2013. *Energy Efficiency Policy Manual Version 5*. Page 32.

<sup>3</sup> KEMA, Inc. 2008. "Summary of EUL-RUL Analysis for the April 2008 Update to DEER." Memorandum submitted to Itron, Inc.

<sup>4</sup> California Public Utilities Commission (CPUC). 2016. Resolution E-4807. December 16. Page 13.

<sup>5</sup> Itron, Inc. 2014. "2010-2012 WO017 Ex Ante Measure Cost Study Final Report." Page 3-39 & 4-31

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

The base case is the customer’s existing insulation. Therefore, the base case labor cost is \$0.00.

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

The 2010-2012 WO17 Ex Ante Measure Cost Study also provides measure case labor for the residential ceiling insulation at \$0.81/square foot.

### 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. These NTG values are based upon the average of all NTG ratios for all evaluated 2006 – 2008 commercial, industrial, and agriculture 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, industrial, and agriculture sector programs for more than two years and for which impact evaluation results are not available.

#### Net-to-Gross Ratios

Parameter	Value	Source
Res-sSF-mShellIns	0.28	DEER READi Tool version 2.5.1 Support Table derived from California Public Utilities Commission (CPUC). 2012. Decision 12-05-015 in the Order Instituting Rulemaking to Examine the Commission's Post-2008 Energy Efficiency Policies, Programs, Evaluation, Measurement, and Verification, and Related Issues (R.09-11-014). Issued May 18, 2012. O.P. 14.  California Public Utilities Commission (CPUC), Energy Division. 2013. Energy Efficiency Policy Manual Version 5. Page 21.

### 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.

#### Gross Savings Installation Adjustment

Parameter	GSIA	Source
Def-GSIA	1.00	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 inputs and methods based upon the Database of Energy Efficient Resources (DEER), and the rationale for inputs and methods that are not DEER-based.

### DEER Difference Summary

DEER Item	Comment
Modified DEER methodology	No
Scaled DEER measure	No
DEER Base Case	Customer existing insulation
DEER Measure Case	<ol style="list-style-type: none"> <li>1. Ceiling - Add R-11 batts on top of vintage-specific existing insulation</li> <li>2. Ceiling - Add R-19 batts on top of vintage-specific existing insulation</li> <li>3. Ceiling - Add R-30 batts on top of vintage-specific existing insulation</li> <li>4. Ceiling - Add R-38 batts on top of vintage-specific existing insulation</li> </ol>
DEER Building Types	Single-Family, Multi-Family and Double-Wide Mobile Homes
DEER Operating Hours	N/A
DEER eQUEST Prototypes	N/A
DEER Version	DEER READi (Version 2.5.1)
Reason for Deviation from DEER	N/A
DEER Measure IDs Used	RB-BS-Ceillns-VintR-Addr11 RB-BS-Ceillns-VintR-Addr19 RB-BS-Ceillns-VintR-Addr30 RB-BS-Ceillns-VintR-Addr38
NTG	Source: DEER READi Tool version 2.5.1 Support Table. The NTG of 0.28 is associated with NTG ID: <i>Res-sSF-mShellIns</i>
GSIA	The GSIA of 1.0 is associated with GSIA ID: <i>Def-GSIA</i>
EUL/RUL	Source: DEER READi Tool version 2.5.1 Support Table EUL ID: <i>BS-Ceillns</i> . The RUL value of 6.7 years is associated with EUL ID: <i>BS-Ceillns</i> .

## REVISION HISTORY

### Measure Characterization Revision History

Revision Number	Revision Complete Date	Primary Author, Title, Organization	Revision Summary and Rationale for Revision
01	12/29/2019	RMS Energy Consulting, LLC	Draft of consolidated text for this statewide measure is based upon: <ul style="list-style-type: none"> <li>• DEER Measure IDs: D03-420 – D03-424</li> <li>• WPSDGEREHC1066, Revision 0</li> </ul> Consensus reached among Cal TF members.
01	06/04/2020	Jeff Cun SoCalGas	Correction in the EAD Tables/savings per PEAR db update to include some missing climate zones.
01	07/16/2020	Jeff Cun SoCalGas	Reverted the workpaper revision number from “-02” (6/4/2020) to “-01” (7/15/2020) as requested by CPUC.