

# **LIEE Standardization Project**

**Draft Phase 1 Report**

Submitted by:

Regional Economic Research, Inc.  
and  
Richard Heath & Associates

April 17, 2000 (Revised)

# Table of Contents

---

<b>1 Introduction .....</b>	<b>1-1</b>
1.1 Background.....	1-1
1.2 Objectives.....	1-2
1.3 Process of Developing Recommendations under Phase I.....	1-3
1.4 Types of Recommendations.....	1-4
1.5 Organization of the Report.....	1-4
<b>2 Policy Analysis.....</b>	<b>2-1</b>
2.1 Background.....	2-1
2.2 Potential Benefits of Uniformity.....	2-1
2.2.1. Statewide Administration .....	2-2
2.2.2. Outsourcing Implementation .....	2-2
2.2.3. Avoiding Customer Confusion.....	2-2
2.2.4. Treating Low-Income Customers Equitably .....	2-3
2.3 Potential Impediments to Uniformity.....	2-3
2.3.1. Differences in Weather Conditions.....	2-3
2.3.2. Differences in Codes and Ordinances.....	2-3
2.3.3. Differences in Needs of Low-Income Customers.....	2-4
2.4 Conclusions.....	2-4
<b>3 Differences in Measure Offerings .....</b>	<b>3-1</b>
3.1 Introduction.....	3-1
3.2 Differences in Measure Eligibility.....	3-1
3.3 Recommended Criteria for Measure Selection.....	3-3
3.3.1. Introduction .....	3-3
3.3.2. Background.....	3-3
3.3.3. Cost-Effectiveness Tests .....	3-4
3.3.4. Recommendations.....	3-6
<b>4 Measure-Specific Policies and Procedures .....</b>	<b>4-1</b>
4.1 Introduction.....	4-1
4.2 Ceiling Insulation.....	4-2
4.2.1. Nonfeasibility Criteria.....	4-2
4.2.2. Other Policies and Procedures.....	4-4
4.3 Caulking.....	4-4
4.3.1. Nonfeasibility Criteria.....	4-4
4.3.2. Other Policies and Procedures.....	4-4
4.4 Weatherstripping Doors.....	4-5
4.4.1. Nonfeasibility Criteria.....	4-5
4.4.2. Other Policies and Procedures.....	4-6
4.5 Low Flow Showerheads and Faucet Aerators.....	4-6
4.5.1. Nonfeasibility Criteria.....	4-6
4.5.2. Other Policies and Procedures.....	4-7

4.6 Water Heater Blankets.....	4-7
4.6.1. Nonfeasibility Criteria .....	4-7
4.6.2. Other Policies and Procedures.....	4-8
4.7 Water Heater Pipe Insulation.....	4-9
4.7.1. Nonfeasibility Criteria .....	4-9
4.7.2. Other Policies and Procedures.....	4-9
4.8 Evaporative Cooler Covers.....	4-9
4.8.1. Nonfeasibility Criteria .....	4-9
4.8.2. Other Policies and Procedures.....	4-10
4.9 Attic Ventilation.....	4-10
4.9.1. Nonfeasibility Criteria .....	4-10
4.9.2. Other Policies and Procedures.....	4-10
4.10 Exterior Door and Window Replacements.....	4-11
4.10.1. Nonfeasibility Criteria .....	4-11
4.10.2. Other Policies and Procedures.....	4-11
4.11 Glass Replacement.....	4-11
4.11.1. Nonfeasibility Criteria .....	4-11
4.11.2. Other Policies and Procedures.....	4-11
4.12 Duct Repairs.....	4-12
4.12.1. Nonfeasibility Criteria .....	4-12
4.12.2. Other Policies and Procedures.....	4-12
4.13 CFL Porch Light Fixtures.....	4-12
4.13.1. Nonfeasibility Criteria .....	4-12
4.13.2. Other Policies and Procedures.....	4-13
4.14 CFL Lamps.....	4-13
4.14.1. Nonfeasibility Criteria .....	4-13
4.14.2. Other Policies and Procedures.....	4-14
4.15 Evaporative Coolers.....	4-14
4.15.1. Nonfeasibility Criteria .....	4-14
4.15.2. Other Policies and Procedures.....	4-15
4.16 Furnace Filter Replacements.....	4-15
4.16.1. Nonfeasibility Criteria .....	4-15
4.16.2. Other Policies and Procedures.....	4-15
4.17 Furnace Repair and Replacement.....	4-15
4.17.1. Nonfeasibility Criteria .....	4-15
4.17.2. Other Policies and Procedures.....	4-16
4.18 Refrigerator Replacement.....	4-16
4.18.1. Nonfeasibility Criteria .....	4-16
4.18.2. Other Policies and Procedures.....	4-16
<b>5 Installation Standards .....</b>	<b>5-1</b>
5.1 Introduction.....	5-1
5.2 Ceiling Insulation.....	5-2
5.3 Caulking.....	5-2
5.4 Weatherstripping Doors.....	5-2
5.5 Low Flow Showerheads and Aerators.....	5-3
5.6 Water Heater Blankets.....	5-3
5.7 Water Heater Pipe Insulation.....	5-3
5.8 Evaporative Cooler Vent Covers.....	5-4
5.9 Attic Ventilation.....	5-4
5.10 Exterior Door and Window Replacements.....	5-4

5.11 Glass Replacement.....	5-4
5.12 Duct Repairs.....	5-5
5.13 CFL Exterior Hardwired Light Fixtures.....	5-5
5.14 Screw-In CFL Lamps.....	5-5
5.15 Furnace Filter Replacements.....	5-5
5.16 Cover Plate Gaskets Standards.....	5-5
<b>6 Summary, Recommendations, and Future Directions .....</b>	<b>6-1</b>
6.1 Summary.....	6-1
6.2 Recommendations.....	6-1
6.3 Future Directions.....	6-2

# 1

## Introduction

---

### 1.1 Background

Since the early 1980s, California's investor-owned natural gas and electricity utilities have offered programs designed to support energy services to the low-income community. These programs have taken a number of forms. At this time, all four utilities administer both California Alternate Rates for Energy (CARE) and Low Income Energy Efficiency (LIEE) Programs. The LIEE Programs consist of weatherization and energy education components. The sole focus of this report is on the LIEE weatherization programs.

The individual utilities' LIEE Programs have evolved somewhat differently over the last several years, and these programs are now characterized by a variety of differences. These differences range from fairly broad differences in policies and procedures to very specific technical differences in installation standards. There have been several attempts to diminish the differences across these programs. For instance, Resolution E-3586 mandated that certain measures be offered by individual utilities on a pilot basis. Even though this resolution permitted some differences to be maintained, it nonetheless moved the four utilities closer to consistency in measure eligibility.

On December 29, 1999, Commissioner Neepor issued an Assigned Commissioner's Ruling (ACR) instructing California's four investor-owned utilities to "work jointly with any interested participants to develop a joint proposal for standardizing the selection criteria and installation manuals for the utilities' low income weatherization programs...." The ACR also instructed the utilities to conduct workshops and/or other forums to solicit input from interested participants, and to submit a joint proposal to the Commission by March 17, 2000. In February, 2000, the four utilities retained RER and RHA to assist in the development of these recommendations.

In light of the significant amount of work to be done in the development of recommendations for standardization, the utilities requested an extension of the due date to May 10, 2000. The approval of this request was conveyed to the utilities in a letter from the Executive Director of the Commission on March 6, 2000.

On March 22, 2000, Commissioner Neeper issued a second ACR relating to the standardization of LIEE programs. This ACR essentially clarified and extended the scope of standardization effort. As indicated in the March 22 ACR, the review of the Policy and Procedures Manuals “shall cover not only issues relating to installation standards, but also other policies and procedures that differ across programs.” Moreover, the ACR instructed the utilities to develop recommendations for standardizing inspection policies and procedures as a second phase of the project.

## **1.2 Objectives**

As defined by the ACRs described above, the primary goal of the overall project is to assist the utilities in achieving consistency in LIEE program policies and procedures, installation standards, and inspection policies and procedures.

The achievement of this broad goal will require a considerable effort on the part of both the utilities and the project team. The work is to be conducted in two phases, and the specific objectives of the project differ across these phases. Phase I of the project, which is the subject of this report, has the following objectives:

- To develop recommendations for a common set of installation standards to be used in all four utility programs;
- To develop recommendations for a consistent set of selection criteria to be used to select measures for inclusion in utility programs; and
- To develop recommendations relating to the achievement of greater consistency in program policies and procedures relating to measure installations.

As will be explained in this report, the first two Phase I objectives have clearly been achieved. The third objective, however, has been only partially met. While the issues associated with some policies and procedures are relatively straightforward, others are not. In the limited time available for Phase I, we have addressed as many of these issues as possible. In some cases, we have been able to develop recommendations for the achievement of greater consistency. In other cases, we have simply described key differences and proposed a procedure for resolving them under Phase II.

The objectives of Phase II will be:

- To implement the recommendations for a common set of installation standards;
- To continue the development of recommendations for increasing consistency in program policies and procedures; and

- To develop recommendations for improving consistency across utilities with regard to inspection policies and procedures.

### **1.3 Process of Developing Recommendations under Phase I**

In the course of developing the recommendations contained in this report, the four utilities, RER and RHA took the following steps:

- In early February, RER met with the utilities to clarify both policies and procedures and installation standards, and to request additional materials relating to the programs.
- On February 22, RER met with the Low Income Advisory Board Technical Committee to discuss the objectives of the project and to solicit input.
- On March 3, RER met with CPUC staff from both the Energy Division and the Office of Ratepayer Advocates. The purpose of the meeting was to discuss project objectives and to establish administrative procedures.
- On March 24, the project team distributed an initial summary of differences in eligible measures, eligible minor home repairs, and installation standards to a list of interested parties including the members of the Low Income Advisory Board, members of the Board's Technical Committee, and other parties that had attended the February 22 meeting.
- On March 28, RER and RHA attended a joint meeting of the Low Income Advisory Board and its Technical Committee to discuss the aforementioned summaries of differences. On March 29, the Technical Committee (including the utilities) further considered these summaries and developed a set of comments and suggestions that was forwarded to the project team.
- On April 7 and April 10, RER and RHA met with the utilities, CSD and CPUC staff to develop recommendations relating to both installation standards and a limited set of policies and procedures.

Prior to the finalization of the recommendations contained in this report, the project team will attend two additional LIAB Technical Committee meetings to solicit public input. These meetings will be held on April 18-9 in Downey and April 25-6 in San Francisco.

We appreciate the involvement of Commission staff, the Community Services Division (CSD), and other interested parties in this process. While these parties may not agree with some or all of the recommendations contained in this report, they nonetheless had a considerable influence on these recommendations.

## **1.4 Types of Recommendations**

For the purposes of this report, we have categorized our recommendations into three general categories. Recommendations relate to:

- The selection of measures to be offered under the Program;
- Measure-specific policies and procedures, including nonfeasibility criteria and other policies and procedures; and
- Installation standards relating to measures currently offered by one or more of the utilities.

## **1.5 Organization of the Report**

The remainder of the report is organized as follows:

- Section 2 discusses the notion of standardization from a policy perspective. It discusses the various arguments for and against standardization of policies, procedures and installation standards.
- Section 3 describes differences in measures offered through the four utility programs and recommends a set of criteria to be used in the selection of measures for these programs.
- Section 4 describes differences in current utility policies and procedures relating to individual measures offered under the Program and recommends a consistent set of measure-specific policies and procedures.
- Section 5 discusses the differences in installation standards across utility programs and provides recommendations for achieving statewide consistency in these standards.
- Finally, Section 6 summarizes the results of the study offers some general suggestions for further work.



# 2

## Policy Analysis

---

### 2.1 Background

The Commission, the LIAB and various other parties have actively promoted statewide standardization of policies, procedures, and installation standards relating to the LIEE weatherization program. In its November 3, 1999 letter to the Commission, the Low Income Governing Board indicated its support for increasing the “uniformity of the implementation and installation of weatherization measures.” This letter reiterated the position the Board had taken in its earlier submittals to the Commission relating to the 1999 and 2000 LIEE Programs.

The utilities have traditionally argued that program policies, procedures and installation standards should allow for differences across service areas. In its testimony relating to its PY2000 program application, for instance, SDG&E argued that the selection of measures should recognize differences across service areas, including climates, local building codes, and ordinances.<sup>1</sup>

Most of the debate on consistency or uniformity in program offerings has been cast in extremely general terms, and has referred to a variety of benefits of and impediments to standardization. In the rest of this section, we review the debate and evaluate some of the arguments it has encompassed. Section 2.2 discusses the potential benefits of uniformity, while Section 2.3 assesses various potential impediments. Section 2.4 attempts to draw some inferences from these discussions on the appropriate objectives of this and other efforts to achieve consistency in program offerings.

### 2.2 Potential Benefits of Uniformity

The standardization of LIEE policies, procedures, and installation standards could have a variety of benefits. Some of the arguments for standardization are discussed below.

---

<sup>1</sup> See Testimony of Yvette M. Vasquez on San Diego Gas & Electric Company’s (U 902-E) Request for Proposals for its PY2000 Low Income Energy Efficiency Programs, September 17, 1999.

### **2.2.1. Statewide Administration**

Early arguments for standardization related to the potential for statewide administration of energy efficiency programs by entities other than the utilities. The LIAB, in its October 21, 1998 comments on the utilities' PY1999 advice filings, argued that "to further the transition of LIEE away from the utilities to the independent program administrators it is very useful to increase the uniformity of measure implementation across all utilities. This is in essence the beginning of the transition process." While the efficient operation of a statewide program by a single administrator would have benefited from a greater degree of standardization, however, near-term plans for statewide administration were abandoned. In its Decision (D.) 99-03-056, the Commission ruled that utilities would continue as interim program administrators through December 31, 2001. AB 1393, which went into effect January 1, 2000, mandates that the utilities shall continue to administer the LIEE programs for the foreseeable future, unless new legislation is passed.<sup>2</sup>

### **2.2.2. Outsourcing Implementation**

In its Decision (D.) 99-03-056, and its Rulemaking (R.) 99-07-037, the Commission ruled that the utilities should outsource and competitively bid program implementation activities to the broadest extent possible.<sup>3</sup> It could be argued that outsourcing program implementation would be facilitated by standardization, in that standard policies, procedures and installation standards could expand the pool of contractors able to bid on the implementation of individual programs. However, to the extent that differences in programs are otherwise justified on the basis of weather, local needs or other legitimate factors, convenience for contractors would not seem to be a significant issue. AB1393 explicitly recognizes the need for contractors to understand the needs of local targeted communities, and it seems reasonable to interpret this mandate to apply to needs-based differences in policies and procedures.

### **2.2.3. Avoiding Customer Confusion**

It has been argued in a variety of forums that uniformity in program offerings will avoid customer confusion. In its Resolution E-3586, for instance, the Commission indicated that

---

<sup>2</sup> In a communication with the Commission, Richard Polanco, the author of AB 1393, and Roderick Wright, Chair of the Assembly Utilities & Commerce Committee, noted the importance of AB 1393 to the standardization efforts: "There still may be arguments in favor of program uniformity even without the possibility of a third party administrator. But California has a diverse climate and housing mix.... How would removing utility management's ability to tailor the program to the needs of its service territory benefit its low income ratepayers?"

<sup>3</sup> See D. 99-03-056, dated March 18, 1999, ordering paragraph 1 and Conclusion of Law 4.

“moving towards a standard statewide set of measures will produce many benefits and may reduce customer confusion.<sup>4</sup> It is unclear that customer confusion is created by cross-utility differences in programs, however, unless customers are involved in multiple programs (perhaps at different points in time). It seems safe to say that most LIEE participants are involved in only a single program, and are thus unaware of and unaffected by differences across programs.

#### **2.2.4. Treating Low-Income Customers Equitably**

Perhaps the most compelling argument for some degree of standardization is the equitable treatment of low-income customers. Equity in this context requires that low income customers in all service areas *facing the same set of circumstances* receive the same services. Equity in this sense is a fairly standard principle in public policy, and the utilities are in agreement that it should be preserved in the design and implementation of LIEE programs.

### **2.3 Potential Impediments to Uniformity**

#### **2.3.1. Differences in Weather Conditions**

Complete uniformity in measure offerings and policies and procedures relating to specific measures (e.g., insulation levels) would clearly disregard the variation in weather conditions across service areas. Since cost effectiveness is one of several accepted criteria for measure selection, and since weather conditions vary substantially across weather zones,<sup>5</sup> it would seem appropriate that current policies allow differences based on weather. Under current practice, these climate differences are only indirectly taken into account through cross-utility differences in policies. For instance, PG&E (which generally faces the highest heating requirements) installs higher levels of ceiling insulation than the other utilities. However, it would seem more appropriate to recognize variations in weather more explicitly through the use of policies and procedures that vary across climate zones. This option is discussed in Section 4.

#### **2.3.2. Differences in Codes and Ordinances**

Codes and ordinances sometimes vary substantially across local jurisdictions, and these variations have been cited frequently as reasons for differences in utility program designs. For instance, PG&E has argued that some stringent local codes relating to wiring may often effectively prevent the installation of hard-wired compact fluorescent porch fixtures.

---

<sup>4</sup> See Discussion paragraph 1 and Findings paragraph 10.

<sup>5</sup> In California, heating degree-days (base 65<sup>o</sup>) vary from roughly 1200 in CEC Climate Zone 15 to almost 6000 in Climate Zone 16. Cooling degree-days range from virtually 0 in Climate Zone 1 to over 3700 in Climate Zone 15.

Moreover, SDG&E has pointed out that insulating over knob-and-tube wiring is prohibited by code in the City of San Diego. It is clear that utility programs cannot encourage or allow for violations of local codes and ordinances, and that this may have implications for service delivery in different jurisdictions. The dominance of local codes and ordinances over program rules is well recognized under current practice, and this practice must clearly continue. However, this need not deter the utilities from developing consistent rules relating to measure installation, with clear instructions that codes and ordinances must be observed if they are more stringent than program rules.

### **2.3.3. Differences in Needs of Low-Income Customers**

It is clear that the low-income population is made up of a diverse set of individuals with distinct needs. What is not so clear is how these differences in needs affect the choice of policies, procedures, and standards. Some impacts are apparent. For instance, low-income populations in various regions may have different language mixes, and program outreach would clearly have to take this into account. Dwellings occupied by low-income households may differ across regions (different mixes of high-rises, low-rises, mobile homes, etc.), and this could have some implications for the implementation of programs. Housing stock conditions in different service area neighborhoods may also vary substantially, based on socio-economic factors facing those neighborhoods. However, we do not see how the issues addressed in this report—measure installation standards, measure-specific policies and procedures, and measure selection criteria—are directly affected by differences in the needs of these communities. Of course, the linkage between broader program policies and procedures covered by Phase II of this study may be addressed explicitly in the statewide Needs Assessment study approved by the Commission in Resolutions E-3601 and E-3646.

## **2.4 Conclusions**

As indicated in the above discussion, some of the arguments both for and against standardization are weak. This discussion offers the following conclusions:

- n The key objective of the standardization effort ought to be equity in the provision of services to low-income communities, rather than complete uniformity. Equity requires that participants facing the same circumstances be provided the same services.
- n Program policies, procedures and installation standards ought to recognize important differences in weather conditions as well as local codes and ordinances. While differences in the needs of local communities may have an impact on the choice of broader program policies and procedures, they do not directly justify differences in installation standards, measure selection criteria, or measure-specific policies and procedures.

- n Differences in weather conditions are best recognized through systematic differences across climate zones rather than through differences across service area boundaries.
- n Differences in local codes and ordinances are best accommodated through the explicit recognition of the precedence of these local policies throughout the program's policies, procedures, and installation standards.

# 3

## Differences in Measure Offerings

---

### 3.1 Introduction

This section reviews current differences in measure offerings across LIEE weatherization programs and discusses a means of determining which measures will be offered through these programs in the future. Section 3.2 describes differences in measure eligibility across the utilities' PY2000 programs. Cross-program variations in eligible measures have arisen over time partly because of differences in program delivery systems, program histories, weather conditions, and local codes. Differences in the professional perceptions of program planners and implementers have also played a role in this area. Many decisions with respect to program designs are affected by a wide range of factors, and there is considerable room for honest differences in the consideration of these factors.

It is probably fair to say that these differences in measure eligibility have been accentuated because of the lack of a common set of criteria for assessing individual measures for inclusion in programs. In Section 3.3, we discuss the development of such a set of criteria.

### 3.2 Differences in Measure Eligibility

Table 3-1 summarizes differences in energy efficiency measure offerings across the four utility service areas described below:

- The SCE/SoCalGas Overlap Area, where the program is administered by SoCalGas using its *Policy and Procedures Manual* and *Weatherization Installation Manual*.
- The SCE Non-Overlap Area, which is that portion of the SCE service area not covered by the SCE/SoCalGas joint utility agreement, and in which the program is operated by SCE using its own policies and procedures and CSD's *Weatherization Installation Manual*;
- The SDG&E service area; and
- The PG&E service area.

**Table 3-1: Cross-Utility Differences in Measure Eligibility**

Measure	SCE Non-Overlap Area	SCE/SoCal Overlap Area	SDG&E	PG&E
Big Six Measures				
Attic Insulation	Yes	Yes	Yes	Yes
Low Flow Showerheads	Yes	Yes	Yes	Yes
Water Heater Blankets	Yes	Yes	Yes	Yes
Weatherstripping	Yes	Yes	Yes	Yes
Caulking	Yes	Yes	Yes	Yes
Minor Home Repairs	Yes	Yes	Yes	Yes
Other Measures				
Outlet Gaskets	Yes (7)	Yes	Yes (7)	Yes
Faucet Aerators	Yes	Yes	Yes (7)	Yes
Pipe Wrap	Yes (7)	Yes	Yes (7)	Yes
Evaporative Coolers	Yes (1)	Yes (6)	Yes (1)(7)	Yes (1)
Furnace Repair/Replacement	Yes (7)	Yes (5)	Yes	Yes
Refrigerator Replacement	Yes	Yes (6)	Yes	Yes
Attic Ventilation	No (3)	No (3)	Yes (2)(7)	Yes (2)(7)
Evaporative Cooler Covers	No	Yes	Yes	Yes
CFL Porch Light Fixtures	Yes (7)	Yes (6)	Yes	Yes
CFLs	Yes (4)	Yes (6)	Yes	Yes
Furnace Filter Replacement	No	No	No	Yes
Duct Register Sealing	No	No	Yes (8)	No

Notes:

(1) PG&E offers a portable evaporative cooler, while the other electric utilities offer a window/wall unit. Offer attic ventilation in conjunction with attic insulation, and as a free standing measure on a pilot basis, per E-3586.

Offer attic ventilation only in conjunction with attic insulation.

Offered through a complementary program and listed in P&P Manual

Offered through a complementary program but not listed in P&P Manual

Not offered by SoCalGas, but offered by SCE outside the jointly administered SoCalGas/SCE program.

Offered as a free-standing measure on a trial basis as a result of E-3586.

Mobile homes only

As shown in Table 3-1, all utilities offer the Big Six measures. These measures were required until recently, and have been core offerings since the inception of these programs. Eligibility for some other measures differs to some extent across programs, although these differences have largely disappeared in recent years. Remaining differences are as follows

- In the SCE/SoCalGas overlap area, LIEE weatherization services are administered by SoCalGas under an inter-utility agreement. The agreement covers some but not all of the measures listed in Table 3-1. For instance, evaporative coolers, refrigerator replacements, hard-wired fluorescent fixtures, and CFLs are excluded from the agreement, but are offered to SCE customers (including low-income households) through other SCE programs.

- While several non-Big Six measures are offered by all utilities, some of these are provided only on a pilot basis by one or more of the utilities. This situation arose out of Resolution E-3586, and applies to outlet gaskets, pipe wrap, furnace replacement, attic ventilation (as a free-standing measure) and CFL porch light fixtures. At the conclusion of these pilots, some decision will need to be made on the eligibility of these measures.
- While all the electric utilities offer evaporative coolers, PG&E provides portable units while the others install window/wall units.
- Evaporative cooler covers are offered by all of the utilities other than SCE.
- Furnace filter replacement is offered only by PG&E.
- Duct register sealing is offered only by SDG&E, and only for mobile homes.

### **3.3 Recommended Criteria for Measure Selection**

#### **3.3.1. Introduction**

Given the above differences in measures and specific home repairs offered by the utilities, and given that some consistencies are only temporary as a result of pilot programs, it would be useful to have a set of consistent statewide criteria to be used for evaluating the addition and/or deletion of measures from programs. Such criteria are addressed in this subsection. Before proceeding, it should be made clear that we are referring to criteria to be used in determining measure eligibility, *not* criteria for the installation of an eligible measure in a particular home. The latter criteria, which are sometimes called nonfeasibility criteria, will be considered later in Section 4.

#### **3.3.2. Background**

There has already been considerable discussion of the appropriate criteria to be used in the selection of measures. Some direction on the selection of measures can be derived from the Public Utilities Code (PUC). Section 2790 of the PUC requires that, in determining the need for a low-income energy efficiency program, utilities take into consideration “both the cost effectiveness of the measures and the policy of reducing the hardships facing low-income households...” Moreover, Section 2790 requires that the consideration of measures other than the Big Six take into account both the cost effectiveness of the measures as a whole and the policy of reducing energy-related hardships facing low-income households.

In its December 22, 1999 filing to the CPUC, the LIAB recommended that “...the selection of energy efficiency measures and programs for low-income customers [should be] based on a combination of quantifiable economic cost-effectiveness tests, non-quantifiable and non-economic factors, and administrative cost-efficiency...” Non-quantifiable factors refer to “comfort levels, hardships, safety and other factors not easily expressed in monetary terms.”



These benefits would include “equity in receipt of program services, increased ability of customers to manage and afford their utility bills, and increased comfort and safety.

### **3.3.3. Cost-Effectiveness Tests**

Most of the discussion of measure selection criteria has focused on the means of estimating cost-effectiveness and the means of integrating consideration of hardship reductions into the decision-making process. There are several options for assessing cost-effectiveness, including the Public Purpose Test (PPT) and the Participant Test.

CPUC policy requires the PPT to be used as one means of evaluating programs, but recognizes the need to use other criteria as well. Moreover, the CPUC Policy Rules do not require that individual programs pass the PPT, only that a utility’s overall portfolio of programs be cost-effective from the perspective of the PPT. Indeed, discussions of cost-effectiveness have focused on programs and program portfolios *exclusive* of low income programs. For low income programs, cost effectiveness tests are generally recognized to apply to choices of program design, rather than to decisions on whether or not a program should be offered. The following discussion relates only to the use of cost effectiveness tests to assess design issues—specifically the choice of specific measures to be offered.

Two general arguments have been advanced against the use of the PPT to evaluate LIEE programs and the measures they offer.

- First, it is argued that the use of avoided costs rather than retail rates to value the benefits from energy savings distorts the application of the PPT to low-income programs.
- Second, it seems to be assumed that the PPT cannot encompass the kinds of non-energy benefits lumped by statute under the rubric of “reducing the hardships facing low-income households.”

These criticisms are considered below.

***The Valuation of Energy Savings.*** As noted above, it is sometimes argued that retail rates, rather than avoided costs, should be used to value the benefits from the energy savings associated with low-income programs, and the PPT is thus an inappropriate test of cost-effectiveness for low-income programs. In its December 22, 1999 filing to the CPUC, for instance, the LIGB argued that “the best measure of economic cost-effectiveness to use for evaluating measures under the low-income energy efficiency programs is a modification of the Participant Test, defined in the California Standard Practice Manual.” A similar point of view was expressed by the Insulation Contractors Association at the February 16, 2000 meeting of the LIAB.

From a technical standpoint, the proper means of valuing energy savings depends partly upon the perspective of the cost-effectiveness test. Given that the avoided cost of energy is currently below residential retail rates, energy savings provide benefits to participants and costs to nonparticipants in the form of higher rates needed to fill the gap between lost revenues (as determined by retail rates) and avoided costs. At the extremes, there are two options:

- If the cost-effectiveness test is meant solely to evaluate the program from the *perspective of the participant* (the low income household), which implies that impacts on nonparticipants *do not matter*, then the participant's cost of energy (the retail rate) is the proper value to use.
- If the test is meant to evaluate a program from a *societal (public) perspective without regard to the distribution of benefits across sectors of society*, the avoided cost of energy is the appropriate value to use in the estimation of energy savings benefits, since it is designed to reflect both participant benefits and nonparticipant costs.

From a technical standpoint, neither of these perspectives is entirely consistent with low-income policy. Clearly, costs incurred by nonparticipants do matter. However, since the primary purpose of the program is to aid a particular sector of society (low income households), this implies that greater weight should be placed on the benefits incurred by low-income households than on the costs incurred by nonparticipants. That is, it should be recognized that costs to nonparticipants matter, but not as much (dollar-for-dollar) as benefits to participants. To allow this, the cost-effectiveness test should be designed to encompass both participant benefits and nonparticipant costs, and policy decisions should be made on the dollar-for-dollar tradeoffs between participant benefits and nonparticipant costs. We do not claim that this is an easy approach, only that it is the technically appropriate approach to evaluating a low income program and the measures it offers. Clearly, some compromises with practicality will undoubtedly have to be made on this point.

***Consideration of Non-Quantifiable Factors.*** Second, it is often argued that the PPT cannot encompass the kinds of non-energy benefits lumped by statute under the rubric of “reducing the hardships facing low-income households.” In its December 22, 1999 filing, the LIGB recommended that “...the selection of energy efficiency measures and programs for low-income customers [should be] based on a combination of quantifiable economic cost-effectiveness tests, non-quantifiable and non-economic factors, and administrative cost-efficiency...” Non-quantifiable factors refer to “comfort levels, hardships, safety and other factors not easily expressed in monetary terms.” These benefits would include “equity in receipt of program services, increased ability of customers to manage and afford their utility bills, and increased comfort and safety.

It is clear that non-energy benefits should be included in any assessment of low income programs and/or measures. This does not necessarily invalidate the use of the PPT, since the PPT, as a form of societal test, is intended to include a wide range of energy and non-energy benefits and costs. Conceptually, the PPT can be structured to consider safety, comfort, and other such benefits associated with low income programs. Although some work has been done to value such benefits, however, the difficulties of placing dollar values on non-energy benefits and costs are obvious. In the absence of considerable efforts to estimate dollar values of these impacts, qualitative means of incorporating them into the assessment of measures will have to be used.

#### **3.3.4. Recommendations**

**NOTE: These recommendations have not yet been developed. Specific recommendations relating to measure eligibility criteria will be included in the final report.**

# 4

## Measure-Specific Policies and Procedures

---

### 4.1 Introduction

This section considers differences in the four utilities' policies and procedures relating to specific Program measures. Three kinds of policies and procedures are covered in the comparisons:

- Nonfeasibility criteria for the Big Six and other measures;
- Other policies and procedures relating to specific measures.

Nonfeasibility criteria formalize conditions under which measures may not be installed in specific homes. As indicated by the LIAB in its Dec. 22, 1999 submittal to the CPUC, they are conditions under which measures "...do not fit the customer's needs, cannot be physically installed, are already in place at or above the threshold levels in the implementation manual, or are in other ways inappropriate..." The interpretation of "fitting the customer's needs" has been a subject of some discussion recently. The LIAB has recommended that measures not yielding significant energy savings or significantly reducing hardships for a specific household be deemed nonfeasible. While we agree that such factors should be taken into account when evaluating measures for general program eligibility, we recommend that they not be construed as nonfeasibility conditions at the household level, since their determination at that level would be problematic. Instead, we suggest that nonfeasibility conditions be restricted to cases where a specific measure:

- Is already present
- Is refused by the customer
- Cannot be physically installed
- Cannot be installed without risk to the household or the contractor
- Is prohibited by code

## **4.2 Ceiling Insulation**

### **4.2.1. Nonfeasibility Criteria**

Table 4-1 presents our recommended nonfeasibility criteria for ceiling insulation. As shown, most of these criteria were previously used by all of the LIEE weatherization programs. One of the major changes is in the area of knob-and-tube wiring. The treatment of knob-and-tube wiring is made considerably more explicit in the installation standards (see section 5). A nonfeasibility condition has also been added to cover the case where disconnected or damaged ducts are present and cannot be repaired.

**Table 4-1: Nonfeasibility Criteria for Ceiling Insulation**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
Existing insulation already consistent with WIS. <sup>1</sup>	✓	✓	✓	✓	✓
Leaky roof	✓	✓	✓	✓	✓
Adequate venting can not be installed.	✓	✓	✓	✓	✓
Hazardous electrical wiring/conditions present.	✓	✓	✓	✓	✓
Enclosed cavity is present.			✓		
Exhaust vents terminating in the attic that can not be vented to the outside are present	✓	✓	✓	✓	✓
Disconnected or damaged space heating / cooling ducts are present and can not be repaired					
<u>All</u> req'd blocking/shielding can not be installed.	✓	✓	✓	✓	✓
Attic Accessibility: <ul style="list-style-type: none"> <li>■ Inspector can not gain safe physical access to all treated areas of the attic<sup>2</sup></li> <li>■ Less than 24" clearance between top of floor joist and bottom of rafters.</li> <li>■ Easy interior or gable access is not present.</li> <li>■ Non-structural obstructions are present</li> </ul>	✓	✓	✓	✓	✓
Unsound structure that will not support the weight of the insulation and installer, such as: <ul style="list-style-type: none"> <li>■ 2" × 4" 48" OC</li> <li>■ Bowed and sagging joists</li> <li>■ Fiberboard ceiling material</li> <li>■ ¼" dry wall ceiling</li> </ul>	✓	✓	✓	✓	✓
Knob-and-Tube Wiring: <ul style="list-style-type: none"> <li>■ Functioning knob-and-tube wiring can not be certified safe by C-10 contractor</li> <li>■ Abandoned K&amp;T wiring is present and has not been disconnected</li> <li>■ Insulation over K&amp;T wiring prohibited by local codes</li> </ul>	✓			✓	✓

<sup>1</sup> This includes the requirement that existing insulation can be covered over, i.e. that it is not something other than fiberglass, cellulose, rockwool, perlite, vermiculite, or redwood bark. CHECK: with J.O. to see if codes cover this.

<sup>2</sup> To ensure inspector access, need to also specify in the installation standards that installer MUST use this same access door(s) to install the insulation.

**4.2.2. Other Policies and Procedures**

Another key policy/procedure relating to ceiling insulation currently differs across the program areas: the determination of the amount of ceiling insulation to be added. The current policies are currently in effect:

- CSD: Install if less than R-19 present.
- PG&E: If existing level is under R-12, bring to R-30; if R-12 or greater, do not add.
- SDG&E, SCE and SoCalGas: If under R-8, add R-16; if R-8 to R-15, add R-11; if R-16 or greater, do not add.

In an effort to make this policy consistent across programs while still recognizing the importance of climate, the utilities will develop criteria for insulation amounts based on existing levels and weather conditions rather than service area boundaries.

**4.3 Caulking**

**4.3.1. Nonfeasibility Criteria**

Table 4-2 presents our recommended nonfeasibility criteria for caulking. Each of these criteria has previously been used by one or more of the programs, so the achievement of consistency required relatively few changes.

**Table 4-2: Nonfeasibility Criteria for Caulking**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
Existing caulking already consistent with WIS.	✓	✓	✓	✓	✓
Cracks do not penetrate the building envelope.	✓	✓	✓	✓	
Cracks too wide to be caulked (wider than 5/8”) that must be repaired/patched.			✓	✓	✓
Customer refusal.	✓	✓	✓	✓	

**4.3.2. Other Policies and Procedures**

Three other policies and procedures are being recommended for caulking in order to bring the utilities into consistency for this measure:

- For homes with lapped siding, door thresholds, door stops and gaps between different materials must be caulked, but seams between lapped siding must not be caulked.

- Exterior caulking above the first floor of a structure is not required if working conditions are unsafe.
- Caulking may not be applied to the exterior of mobile homes.

## 4.4 Weatherstripping Doors

### 4.4.1. Nonfeasibility Criteria

Table 4-3 presents our recommended nonfeasibility criteria for weatherstripping doors.

**Table 4-3: Nonfeasibility Criteria for Weatherstripping Doors**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
Existing weatherstripping already consistent with WIS.	✓	✓	✓		✓
Door is located between two conditioned or two unconditioned spaces.	✓	✓	✓	✓	✓
Where weatherstripping would create a safety hazard or physical hardship for the resident, such as use of a threshold for resident who uses wheel chairs or walkers.	✓	✓			✓
Door in multi-unit dwelling separating the living space from an unheated hallway where the threshold would create the only rise in an otherwise flat floor.	✓	✓			
Doors with a fire-rating greater than 20 minutes.				✓	
Metal doors and fire-rated doors that can not be cut to accommodate a shoe.	✓	✓			✓
Functional storm door present	✓	✓			
Appliance Enclosure Doors:					
■ Combustion appliance receives air from conditioned space (i.e. combustion air grilles present in the enclosure door or wall)	✓	✓		✓	✓
■ Inadequate combustion air as defined in an appendix to the WIS manual is not provided to the appliance by existing vents AND combustion air supply can not be made adequate within the guidelines of the WIS Manual. <sup>3</sup>	✓	✓		✓	✓
■ Customer refuses modifications needed to create adequate combustion air supply					✓

<sup>3</sup> Appendix would provide a reference for determining vent, and WIS manual section would establish guidelines for increasing the vent air, i.e. changing 1/8" mesh to 1/4" mesh, how to enlarge the vents, etc.



#### 4.4.2. Other Policies and Procedures

Only one other policy is recommended to bring the utilities into consistency for door weatherstripping:

- The contractor may adjust existing weatherstripping in lieu of replacement if existing material meets material standards.

### 4.5 Low Flow Showerheads and Faucet Aerators

#### 4.5.1. Nonfeasibility Criteria

Table 4-4 presents our recommended nonfeasibility criteria for low flow showerheads and Table 4-5 presents our recommended nonfeasibility criteria faucet aerators.

**Table 4-4: Nonfeasibility Criteria for Low Flow Showerheads**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
Existing showerhead(s):					
■ Has flow rate less than 3.0 gpm					✓
■ Is required for medical reasons.	✓	✓	✓	✓	✓
■ Customer refuses replacement.	✓	✓		✓	✓
Existing shower arm:					
■ Is made of plastic.	✓	✓	✓	✓	✓
■ Is cracked, broken, or missing.	✓	✓	✓	✓	✓
■ Requires removal.			✓		
Shower is not mechanically functional.	✓	✓	✓	✓	✓
Standard adapters will not work.	✓	✓	✓	✓	✓
Piping is in such poor condition that showerhead installation could cause plumbing problems.			✓		

**Table 4-5: Nonfeasibility Criteria for Faucet Aerators**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
Existing aerators already consistent with WIS.	✓	✓	✓	✓	✓
Faucet has a special fitting for attaching an appliance (e.g. portable dishwasher).	✓	✓	✓	✓	
Faucet does not provide hot water.	✓	✓			
Faucet or faucet threads are found to be damaged and/or leak.			✓	✓	✓
Standard aerators will not fit.	✓	✓	✓	✓	✓
Installation refused by customer.	✓	✓		✓	

#### **4.5.2. Other Policies and Procedures**

The following miscellaneous policies are recommended for low flow showerheads:

- Only one showerhead may be installed per neck.
- Replaced showerheads must be left with the customer or the property manager if requested.

### **4.6 Water Heater Blankets**

#### **4.6.1. Nonfeasibility Criteria**

Our recommended nonfeasibility criteria for water heater blankets are presented in Table 4-6, Table 4-7, and Table 4-8. Table 4-6 relates to all units regardless of fuel, while Tables 4-7 and 4-8 relate to gas and electric units, respectively. As shown, all of these conditions have been used by at least one program in the past, and most have been used by most or all programs.

**Table 4-6: Nonfeasibility Criteria for Water Heater Blankets (All Units)**

<b>Recommended Nonfeasibility Criteria</b>	<b>Status under Current Programs</b>				
	<b>CSD</b>	<b>SCE*</b>	<b>SoCal</b>	<b>SDG&amp;E</b>	<b>PG&amp;E</b>
Existing blanket is already consistent with WIS and in good condition.	✓	✓	✓	✓	✓
External insulation is prohibited by manufacturer or would invalidate manufacturer warranty.	✓	✓	✓	✓	✓
T&P valve is not present, or is not located within 6” of the tank.	✓	✓		✓	✓
T&P valve outlet is plugged or capped.			✓		
Tank is exposed to the elements.	✓	✓	✓	✓	✓
Leak present in tank or water pipes.	✓	✓	✓	✓	
Cold or hot water lines to/from tank include plastic piping (e.g. PVC)	✓	✓		✓	
Tank is located within 12” of a stove, range, or cooktop.	✓	✓	✓	✓	✓
Water heating system utilizes a recirculating pump.				✓	
Water heating capacity is over 100 gallons.				✓	
Perimeter clearances prior to blanket installation:			✓		✓
■ Front, sides and back: Less than 1”	✓	✓		✓	
■ For gas water heaters: If non-metal door, less than 4” between tank and door	✓	✓	✓	✓	✓

**Table 4-7: Nonfeasibility Criteria for Water Heater Blankets (Gas Units)**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
Gas leak present.	✓	✓	✓	✓	✓
Vent pipe and/or draft hood not properly installed including:					
■ No draft hood present.	✓	✓	✓	✓	✓
■ Two draft hoods present.	✓	✓	✓	✓	✓
■ Vent pipe defective or missing.	✓	✓	✓	✓	✓
Evidence of improper combustion and/or venting including:					
■ Large accumulation of soot near draft hood or on floor underneath.	✓	✓	✓	✓	✓
■ Scorching at draft hood or combustion chamber.	✓	✓		✓	✓
No appliance line (gas shut-off) valve present.	✓	✓		✓	✓
Combustion air supply improper or inadequate:			✓		✓
■ Both low and high vents not present.	✓	✓		✓	
■ Vent size too small.	✓	✓			
■ Room volume inadequate.	✓	✓			
Both burner access doors are missing.	✓	✓	✓	✓	
If there is at least one access door present but signs of scorching or incomplete combustion.					✓
Internal insulation is R-12 or greater.	✓	✓		✓	✓

**Table 4-8: Nonfeasibility Criteria for Water Heater Blankets (Electric Units)**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
Hazardous electrical wiring/conditions present.	✓	✓	✓	✓	✓
Thermostat cover plate not present <sup>4</sup> .	✓	✓	✓	✓	✓
Internal insulation is R-16 or greater.	✓	✓			✓

**4.6.2. Other Policies and Procedures**

One other policy is recommended for use by all utilities for multifamily units:

- Only water heaters supplying hot water to dwelling units receiving weatherization are eligible to receive water heater blankets.

<sup>4</sup> Ask J.O. about this one. Is this a safety issue? If not, can blanket still be installed if the thermostat cover plate is missing?

## 4.7 Water Heater Pipe Insulation

### 4.7.1. Nonfeasibility Criteria

Table 4-9 presents our recommended nonfeasibility criteria for water heater pipe insulation.

**Table 4-9: Nonfeasibility Criteria for Water Heater Pipe Insulation**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
Existing pipe insulation is already consistent with WIS.	✓	✓	✓		✓
Water heater blanket is nonfeasible or any of the water heater nonfeasibility criteria are applicable.	✓	✓	✓	✓	✓
Pipes leak.	✓	✓	✓	✓	✓
Pipes are exposed to the elements.	✓	✓	✓	✓	✓
Insulation can not be started within 3” of where the pipe exits the top of the tank.					✓
Less than 1 foot of insulation can be installed.					✓
Cold or hot water lines to/from tank include plastic piping (e.g. PVC)	✓	✓			
Pipes are inaccessible or configuration prevents proper installation.			✓		✓

### 4.7.2. Other Policies and Procedures

No other changes in policies relating to pipe insulation are recommended.

## 4.8 Evaporative Cooler Covers

### 4.8.1. Nonfeasibility Criteria

Table 4-10 presents our recommended nonfeasibility criteria for evaporative cooler covers. No criteria are currently used by SCE because SCE is not presently offering this measure.

**Table 4-10: Nonfeasibility Criteria for Evaporative Cooler Covers**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
Existing evaporative cooler covers are already consistent with WIS.	✓		✓	✓	
Electrical connections/plugs prevent installation.	✓		✓	✓	
<u>ALL</u> vents cannot be covered.					
Water damage to ceiling or wall area around the register is evident.	✓		✓	✓	✓
Vent opening is so close to wall or ceiling that covers consistent with standards can not be installed.	✓		✓	✓	
Cooler vent/duct is shared with heating system.	✓			✓	✓
An external cover is present.					✓
Customer refusal.					

**4.8.2. Other Policies and Procedures**

No other changes in policies relating to evaporative cooler covers are recommended.

**4.9 Attic Ventilation**

**4.9.1. Nonfeasibility Criteria**

Table 4-11 presents our recommended nonfeasibility criteria for attic ventilation.

**Table 4-11: Nonfeasibility Criteria for Attic Ventilation**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
Existing venting is already consistent with WIS.	✓	✓	✓	✓	✓
Tiled hip roof without overhang, soffit, or accessible frieze blocks.	✓	✓		✓	✓
Ceiling insulation is nonfeasible.	✓	✓	✓		✓
If power ventilator exists.				✓	✓
Roof in poor condition (e.g. more than 3 layers of roofing, roof unable to support additional vents).					✓
Customer refusal.					

**4.9.2. Other Policies and Procedures**

No other changes in policies relating to attic ventilation are recommended.

## 4.10 Exterior Door and Window Replacements

### 4.10.1. Nonfeasibility Criteria

Table 4-12 presents our recommended nonfeasibility criteria for exterior door and window replacement standards.

**Table 4-12: Nonfeasibility Criteria for Exterior Door and Window Replacement**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
Repair is not feasible.	✓	✓	✓	✓	✓
Door/window is structurally sound and provides a reasonable infiltration barrier.			✓		

### 4.10.2. Other Policies and Procedures

No other changes in policies relating to door and window replacement are recommended.

## 4.11 Glass Replacement

### 4.2.1. Nonfeasibility Criteria

Table 4-13 presents our recommended nonfeasibility criteria for glass replacement standards. With one minor exception, these are the same criteria as used by all of the programs currently.

**Table 4-13: Nonfeasibility Criteria for Glass Replacement**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
No more than two small (BB) holes, 1/4" or less in diameter, that can be patched with clear silicone.	✓	✓	✓	✓	✓
No more than one crack less than 6" long, extending from edge to edge, that can not come lose from the frame to pose a safety hazard.	✓	✓	✓	✓	✓
Complete window will be replaced.	✓	✓		✓	✓

### 4.11.2. Other Policies and Procedures

No other changes in policies relating to glass replacement are recommended.

## **4.12 Duct Repairs<sup>5</sup>**

### **4.12.1. Nonfeasibility Criteria**

Table 4-14 presents our recommended nonfeasibility criteria for duct repair standards.

**Table 4-14: Nonfeasibility Criteria for Duct Repairs**

<b>Recommended Nonfeasibility Criteria</b>	<b>Status under Current Programs</b>				
	<b>CSD</b>	<b>SCE*</b>	<b>SoCal</b>	<b>SDG&amp;E</b>	<b>PG&amp;E</b>
There may be some configurations of duct systems that should not be weatherized, such as use of crawlspace or cavities as a plenum? ASK JIM. Also, what about sealing the HVAC system.					

### **4.12.2. Other Policies and Procedures**

No other changes in policies relating to duct repairs are recommended.

## **4.13 CFL Porch Light Fixtures**

### **4.13.1. Nonfeasibility Criteria**

Table 4-15 presents our recommended nonfeasibility criteria for CFL porch light fixtures.

---

<sup>5</sup> This is a new section of the WIS manual as proposed at the April 7 and April 10 LIAB meetings.

**Table 4-15: Nonfeasibility Criteria for CFL Porch Light Fixtures**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
Existing location of fixture is not suitable.	✓	✓		✓	✓
A screw-in CFL will fit in the existing fixture.					✓
Electrical box is substandard and/or can not be properly secured.	✓	✓		✓	
Wiring is substandard, is in a deteriorated condition, and/or rewiring is necessary. <sup>6</sup>	✓	✓		✓	
Circuit does not operate properly (e.g. defective switch).	✓	✓		✓	
Circuit is controlled by a dimmer.	✓	✓		✓	
Wet location with no grounding conductor available.	✓	✓		✓	
Existing fixture is not on customer's electric meter/bill.					✓
Dwelling is not owner-occupied.					✓
Customer refusal.					

**4.13.2. Other Policies and Procedures**

Two policies relating to CFL porch light fixtures will be adopted by all of the utilities:

- No more than an average of three fixtures may be installed.
- Replaced porch light fixtures must be left with the customer or the property manager if requested.

**4.14 CFL Lamps**

**4.14.1. Nonfeasibility Criteria**

Table 4-16 presents our recommended nonfeasibility criteria for low flow showerheads and faucet aerators.

<sup>6</sup> Add “or aluminum”? There was an issue raised at the meeting about aluminum wiring, that some sort of special grease had to be used if aluminum wiring was joined to copper wiring.



**Table 4-16: Nonfeasibility Criteria for CFL Lamps**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
Socket/fixture is nonfunctional.					✓
Hazardous conditions exist at socket/fixture such as broken fixture, missing parts, substandard electrical connections/components, or signs of arcing.	✓	✓		✓	✓
Circuit is controlled by a dimmer or timer.					✓
Fixture is in a storage room, closet, or multifamily common area.					✓
Fixture is not on customer's electric meter/bill.					✓
Customer refusal.					✓

**4.14.2. Other Policies and Procedures**

One policy relating to CFLs will be adopted by all of the utilities:

- A maximum of five CFLs will be installed in any home.

**4.15 Evaporative Coolers**

**4.15.1. Nonfeasibility Criteria**

Table 4-17 presents our recommended nonfeasibility criteria for low evaporative coolers.

**Table 4-17: Nonfeasibility Criteria for Evaporative Coolers**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
Customer already has a functional evaporative cooler.		✓			✓
Electrical outlets or wiring conditions are not safe and adequate for the load.		✓			✓
Outlets not compatible with the evaporative cooler plug.					✓
Outlets not properly grounded.					
Unit can not be plugged directly into outlet without using an extension cord.		✓			
Location would violate any standard/safety code requirements.		✓			

**4.15.2. Other Policies and Procedures**

No other changes in policies are recommended for this measure.

**4.16 Furnace Filter Replacements**

**4.16.1. Nonfeasibility Criteria**

Table 4-18 presents our recommended nonfeasibility criteria for furnace filter replacements.

**Table 4-18: Nonfeasibility Criteria for Furnace Filter Replacements**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
Appliance is not operable.	✓				✓
A serviceable, reusable filter is already installed.	✓				✓
Types of filters provided by the program are prohibited by the appliance manufacturer.	✓				✓
Appliance is not designed to have a filter, such as a wall furnace with circulating fan.	✓				✓
Filter replacement would require removal of a flue, duct, or pipe.	✓				✓
The proper filter support or retaining device is not present and installation is not feasible.	✓				✓
Customer refusal.					

**4.16.2. Other Policies and Procedures**

No other changes in policies are recommended for this measure.

**4.17 Furnace Repair and Replacement**

**4.17.1. Nonfeasibility Criteria**

Table 4-19 presents our recommended nonfeasibility criteria for furnace repair and replacement.

**Table 4-19: Nonfeasibility Criteria for Furnace Repair and Replacement**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
Existing furnace is non-operational or operating under hazardous conditions.					✓
Residence is not owner-occupied.					✓

**4.17.2. Other Policies and Procedures**

No other changes in policies are recommended for this measure.

**4.18 Refrigerator Replacement**

**4.18.1. Nonfeasibility Criteria**

Table 4-20 presents our recommended nonfeasibility criteria for refrigerator replacement.

**Table 4-20: Nonfeasibility Criteria for Refrigerator Replacement**

Recommended Nonfeasibility Criteria	Status under Current Programs				
	CSD	SCE*	SoCal	SDG&E	PG&E
Existing refrigerator is less than 10 years old.				✓	
Hazardous electrical conditions at outlet to which existing refrigerator is connected.				✓	
Customer does not own existing refrigerator.				✓	

**4.18.2. Other Policies and Procedures**

No other changes in policies are recommended for this measure.

# 5

## Installation Standards

---

### 5.1 Introduction

The development of recommendations for consistent installation standards was the major accomplishment of the first phase of the project. In general, the utilities' installation standards were already similar, and most differences were fairly easily resolved. However, the resolution of some issues required considerable flexibility on the parts of program staff. Two full-day meetings were held to consider and resolve differences across individual utilities' manuals. The end result of this process is a common set of standards that the utilities recommend be integrated into a single installation standards manual for use in all utility programs. These standards are contained in Appendix A of this report.

In the course of reconciling differences in installation standards, the utilities also took the opportunity to make some general improvements in these standards. The following general changes were made:

- The manual was made more explicit with respect to materials. General statements like "...or equivalent" were removed, and the manual was reworded to more specifically call out approved and acceptable materials.
- Requirements for lead-safe practices were specified for all measures.
- Excerpts from key codes governing installation were included to ensure that these requirements are met.
- References to "properly installed" were replaced by explicit references to sections of the manual that detail the requirements of proper installation.
- A general requirement for proper cleanup and disposal of materials was added as part of installation procedures.

In the remainder of this section, we highlight some of the features of the common installation standards developed as part of this study. In general, these highlights relate to cases where substantive differences in the utilities' standards were found.

## **5.2 Ceiling Insulation**

Section 3 of Appendix A contains the common set of ceiling installation standards recommended by the utilities for adoption by the Commission. As shown there, these standards have the following key features:

- Fully defined knob-and-tube wiring requirements
- A requirement that abandoned knob-and-tube wiring must either be completely removed or physically disconnected to prevent the possibility of re-energizing the system plus C-10 certified as abandoned, before ceiling insulation can be installed.<sup>1</sup>
- The adoption of Uniform Building Code (UBC) attic ventilation requirements as the standard.
- The requirement that IC-Labeled fixtures be blocked like any other heat producing device (HPD).
- A requirement for abandoned vent pipes to be blocked.
- A requirement that closet vents open to the attic and not used for combustion air supply be covered with a removable cover unless refused by the customer.
- A requirement that hinged lids for disappearing stairs will be installed and insulated if not already present.

## **5.3 Caulking**

Section 1 of Appendix A contains the proposed caulking standards. In general, recommended caulking standards are very similar to those currently used by the utilities. However, the recommended standard stipulates that, if caulking of recessed lights/HPDs is done, it must be done from the attic side.

## **5.4 Weatherstripping Doors**

As shown in Section 2 of Appendix A, weatherstripping standards recommended for adoption have the following key features:

- The omission of window weatherstripping standards, since windows are not weatherstripped by the utilities or CSD.
- Inclusion of a definition of cushion synthetic in the materials standard.
- Clarified specifications for threshold screws to eliminate protruding screwheads.

---

<sup>1</sup> Exact understanding and wording of these requirements is still being finalized.

- Elimination of vinyl V-Strip as an acceptable weatherstripping material.
- A requirement that solid aluminum **carriers** must be used for all shoes, door bottoms, and sweeps.
- Disallowal of flip type sweeps.
- Allowance of bumper thresholds.

## **5.5 Low Flow Showerheads and Aerators**

As indicated in Section 9 of Appendix A, recommended standards for low flow showerheads and faucet aerators are very similar to those currently used by the utilities. Minor differences in wording have been reconciled.

## **5.6 Water Heater Blankets**

Section 6 of Appendix A contains the proposed water heater blanket installation standards. These standards incorporate the following specifications:

- Blanket straps must be polypropylene, as indicated by the removal of the phrase "...or equivalent" from material specifications.
- Blanket R-Value will be specified as "R-6 Minimum;" the recommendation for R-12 has been dropped.
- A minimum of three blanket straps is required, and the requirement for the snugness of the blanket has been rephrased.
- Blanket flaps covering tank labels or components, including the flap covering "I. D. Label" (i.e. manufacturer/model number) must be cut.
- Insulation not installed if both internal and external access doors are missing, but is allowed if at least one door is present and there are no signs of scorching or incomplete combustion.

## **5.7 Water Heater Pipe Insulation**

Section 7 of Appendix A contains the recommended water pipe insulation standards. As shown there, the following the standards:

- Prohibit the use of mineral fiber pipe insulation.
- Require that the start of Insulation must be within 3" of where pipe exits from the tank.

## **5.8 Evaporative Cooler Vent Covers**

Proposed installation standards for evaporative cooler and air conditioner vent covers are contained in Section 10 of Appendix A. These standards are very similar to those already used by the utilities offering this measure, except that.

- Wood covers will now be allowed by all utilities.
- All vents/registers must be covered.
- Toggle bolts are now allowed/specified for latching of covers.

## **5.9 Attic Ventilation**

The recommended attic ventilation standards are contained in Section 4 of Appendix A. They contain the following key provisions:

- Net free venting must be consistent with UBC requirements.
- Venting will not be installed roof is built-up type or in poor condition.
- 1/16" insect screen and clogged vents will be replaced with 1/8" to 1/4" metal mesh.

## **5.10 Exterior Door and Window Replacements**

Section 12 of Appendix A contains recommended installation standards for exterior door and window replacements. Some of the features of these standards are:

- A window U-value requirement of 0.55 to be met if all windows in a residence are replaced.
- Fully specified requirements for safety glass.
- Disallowal of stacked strike plates.
- Adoption of UBC window egress requirements in the absence of controlling local codes.

## **5.11 Glass Replacement**

As indicated in Section 13 of Appendix A, recommended glass replacement standards are very similar to those currently used by the utilities. Minor differences in wording have been reconciled.

## **5.12 Duct Repairs**

A new set of duct repair standards has been developed. It is contained in Section 5 of Appendix A.

## **5.13 CFL Exterior Hardwired Light Fixtures**

Section 15 of Appendix A contains the proposed installation standards for hard-wired fluorescent fixtures.

## **5.14 Screw-In CFL Lamps**

Section 14 of Appendix A contains the proposed installation standards for screw-in CFLs.

## **5.15 Furnace Filter Replacements**

Section 11 of Appendix A provides proposed standards for furnace filter replacements. The standards are the same as those used by PG&E, the only utility offering this measure.

## **5.16 Cover Plate Gaskets Standards**

The utilities are recommending that outlet gaskets be dropped from all programs. As a result, no installation standards for this measure are included in Appendix A.



# 6

## Summary, Recommendations, and Future Directions

---

### 6.1 Summary

This report describes an intensive effort by California’s investor-owned utilities to develop recommendations for standardizing the measure selection criteria, installation standards, and measure-specific policies and procedures used in their LIEE weatherization programs. The effort was in response to Commissioner Nepper’s December 29, 1999, which instructed the utilities to “develop a joint proposal for standardizing the selection criteria and installation manuals for the utilities’ low income weatherization programs.”

RER and RHA were retained by the utilities to provide technical and administrative assistance during the process of developing recommendations. As described in Section 1, several meetings were held to obtain input for this process. RER, RHA, and the utilities met with the Low Income Advisory Board and its Technical Committee to obtain public input. Moreover, RER and RHA conducted two full-day working meetings with the utilities, CSD, and CPUC staff to discuss cross-program differences and to develop consistent standards and policies. The recommendations contained in this report are the result of this process.

### 6.2 Recommendations

In this report, the utilities offer three types of recommendations:

- Recommendations for the determination of measure eligibility are presented in Section 3. As indicate there (NOTE: THESE RECOMMENDATIONS WILL BE COMPLETED PRIOR TO THE SUBMISSION OF THE FINAL REPORT.)
- Recommendations for consistent policies relating to the installation of specific measures are presented in Section 4. These policies include standardized nonfeasibility criteria as well as other policies relating to amounts of various measures and other miscellaneous policies and procedures.
  - Nonfeasibility criteria are limited to conditions relating to the presence of a measure, refusal by a customer, physical impediments to installation, prohibitions by local codes and ordinances, and safety or health risks associated with installation. It is important to note that cost effectiveness is not proposed as a nonfeasibility criterion, insofar as cost-effectiveness screens

should be applied at the program (or climate zone) level rather than at the household level.

- Other measure-specific policies and procedures cover a wide range of issues. Of particular note in this area is the recommendation that required ceiling insulation levels be determined on a climate zone basis rather than on a service area basis. A specific set of guidelines on insulation levels will be developed in the next phase of this project.
- The utilities recommend a common set of installation standards for use in all utility LIEE weatherization programs. A set of proposed installation standards is contained in Appendix A of this report and discussed very briefly in Section 5. These standards will be integrated into a common Statewide Weatherization Installation Standards (WIS) Manual in the next phase of this study. The utilities propose that the Statewide WIS Manual be designed to include three types of information for each measure offered by one or more utilities:
  - the installation standards for the measure;
  - nonfeasibility criteria for the installation of the measure; and
  - a summary of other specific policies and procedures relating to the installation of the measure.

The logic of this comprehensive design is that it would provide field personnel with a single reference for all policies, procedures and standards relating to program measure.

### **6.3 Future Directions**

This report has focused on measure-specific policies and procedures and installation standards. The Commission has directed the utilities to assess the standardization of a wide range of other LIEE policies and procedures, including measure eligibility, income qualification, program management, home energy audits, carbon monoxide and combustion appliance safety testing, and inspection policies and procedures. These issues will be addressed in the next phase of this study.

# ***Appendix A***

## **Conventional Home Weatherization Installation Standards**

---

**Section 1: Caulking Standards**

**Section 2: Weatherstripping Standards**

**Section 3: Ceiling Insulation Standards**

**Section 4: Attic Ventilation Standards**

**Section 5: Duct Repair Standards**

**Section 6: Water Heater Insulation Standards**

**Section 7: Water Heater Pipe Insulation Standards**

**Section 8: Cover Plate Gasket Standards**

**Section 9: Low Flow Showerhead and Faucet Aerator Standards**

**Section 10: Evaporative Cooler and Air Conditioner Vent Cover Standards**

**Section 11: Central HVAC and Wall/Window Air Conditioner Filter Standards**

**Section 12: Exterior Door and Window Replacement Standards**

**Section 13: Glass Replacement Standards**

**Section 14: Screw-In Compact Fluorescent Lamp Standards**

**Section 15: Hard-Wired Fluorescent Fixture Installation Standards**

## ABBREVIATIONS AND ACRONYMS

<b>AAMA</b>	American Architectural Manufacturers Association
<b>ACCA</b>	Air Conditioning Contractors of America
<b>ACDD</b>	Annual Cooling Degree Days
<b>AFUE</b>	Annual Fuel Utilization Efficiency
<b>AGA</b>	American Gas Association
<b>AHDD</b>	Annual Heating Degree Days
<b>ANSI</b>	American National Standards Institute
<b>ARI</b>	Air Conditioning and Refrigeration Institute
<b>ASME</b>	American Society of Mechanical Engineers
<b>ASHRAE</b>	American Society of Heating, Refrigerating and Air-Conditioning Engineers
<b>ASTM</b>	American Society for Testing and Materials
<b>AWG</b>	American Wire Gage
<b>BEAR</b>	Bureau of Electronic and Appliance Repair
<b>BEF</b>	Ballast Efficacy Factor
<b>BOCA</b>	Building Officials and Code Administrators
<b>Btu</b>	British Thermal Unit
<b>Btu/hr</b>	British Thermal Units per Hour
<b>°C</b>	Degrees Centigrade
<b>CABO</b>	Council of American Building Officials
<b>CalOSHA</b>	California Occupational Safety and Health Administration
<b>CAS</b>	Combustion Appliance Safety
<b>CASIF</b>	Combustion Appliance Safety Inspection Form
<b>CAZ</b>	Combustion Appliance Zone
<b>CBO</b>	Community Based Organization
<b>CBM</b>	Certified Ballast Manufacturers
<b>CCR</b>	California Code of Regulations
<b>CEC</b>	California Energy Commission
<b>CFL</b>	Compact Fluorescent Lamp
<b>CFM, cfm</b>	Cubic Feet per Minute
<b>CFM<sub>25</sub>, CFM<sub>50</sub></b>	Cubic Feet per Minute of Air Flow at 25 (50) Pascals of Pressure
<b>CFR</b>	Code of Federal Regulations
<b>CO</b>	Carbon Monoxide
<b>COP</b>	Coefficient of Performance
<b>CPSC</b>	Consumer Products Safety Commission
<b>CSD</b>	California Department of Community Services and Development
<b>DOE</b>	(United States) Department of Energy
<b>DV</b>	Direct Vent (Furnace/Heater)
<b>ESP</b>	Economic Stop Parameters/Economic Stop Policy
<b>EPA</b>	Environmental Protection Agency
<b>°F</b>	Degrees Fahrenheit

## ABBREVIATIONS AND ACRONYMS

<b>FAU</b>	Forced Air Unit
<b>fpm</b>	Feet per Minute
<b>F.S.</b>	Federal Specifications
<b>GFCI</b>	Ground Fault Circuit Interrupter
<b>HCD</b>	(California Department of) Housing and Community Development
<b>HDL</b>	House Depressurization Limit
<b>HPD</b>	Heat Producing Device
<b>HUD</b>	(U.S. Department of) Housing and Urban Development
<b>HVAC</b>	Heating Ventilation and Air Conditioning
<b>Hz</b>	Hertz
<b>ICBO</b>	International Conference of Building Officials
<b>ID</b>	Inside Diameter
<b>IWC, iwc</b>	Inches of Water Column (Same as WG, Inches of Water Gauge)
<b>IWG, iwg</b>	Inches of Water Gauge (Same as IWC, Inches of Water Column)
<b>kHz</b>	Kilohertz
<b>MVR</b>	Minimum Ventilation Requirement
<b>NEC</b>	National Electrical Code
<b>NEMA</b>	National Electrical Manufacturers Association
<b>NFPA</b>	National Fire Protection Association
<b>NFRC</b>	National Fenestration Rating Council
<b>NFV Area</b>	Net Free Venting Area (Total vent opening area minus the blocking effect of louvers, grilles and screens)
<b>OC</b>	On Center
<b>OD</b>	Outside Diameter
<b>OSHA</b>	Occupational Safety and Health Administration
<b>P&amp;P</b>	Policies & Procedures
<b>Pa</b>	Pascal (1 Pa = 0.004 iwc, and 1 iwc = 250 Pa)
<b>PPM, ppm</b>	Parts Per Million
<b>psi</b>	Pounds per Square Inch
<b>psf</b>	Pounds per Square Foot
<b>RTV</b>	Room Temperature Vulcanization (e.g., RTV Silicone)
<b>SEER</b>	Seasonal Energy Efficiency Ratio
<b>T&amp;P Valve</b>	Temperature and Pressure Relief Valve
<b>TPE</b>	Thermoplastic Elastomer
<b>UBC</b>	Uniform Building Code
<b>UL</b>	Underwriters Laboratories
<b>UMC</b>	Uniform Mechanical Code
<b>UPC</b>	Uniform Plumbing Code
<b>UV</b>	Ultraviolet
<b>WC, wc</b>	Water Column (Same as Water Gauge)
<b>WG, wg</b>	Water Gauge (Same as Water Column)

## ABBREVIATIONS AND ACRONYMS

<b>WIS</b>	Weatherization Installation Standards
<b>Wx</b>	Weatherization

<b>Backdrafting</b>	The reverse flow of combustion gases down the vent pipe and out the draft hood of a natural vent open combustion appliance. Intermittent backdrafting can be caused by wind gusts. Ongoing backdrafting can be the result of a negative pressure in the combustion appliance zone (CAZ) caused by (a) duct system return leaks in the vicinity of the appliance, and/or (b) the excessive influence of mechanical systems exhausting air from the structure (e.g., bathroom and utility room exhaust fans, range hood fan, clothes dryer, built-in vacuum system, etc.).
<b>Drawband</b>	A device which encircles a duct and mechanically secures the core-to-fitting attachment (i.e., a synthetic duct tie or a worm drive stainless steel clamp). Duct ties are also used to secure fiberglass duct wrap and to seal jacket overlaps at flexible duct splices.
<b>Closure System</b>	The sum total of components utilized to secure and seal a duct system joint or seam against air leakage (e.g., pressure sensitive tape, or heat activated tape, or mastic with fiberglass mesh reinforcement). Closure systems for non-metallic flexible ducts include a drawband.
<b>Combustion Appliance Zone (CAZ)</b>	The room or area of a home in which an open combustion natural draft appliance (typically a furnace, water heater, wood burning stove or fireplace) is located. It could be a living room containing a wood burning stove, a kitchen or utility porch containing a water heater, or an appliance enclosure. Excessive depressurization of the CAZ causes backdrafting and spillage of combustion gases.
<b>Heat Activated Tape</b>	Metallic tape with an adhesive coating which is activated and cured by the application of heat and pressure.
<b>Lapped Seam</b>	The seam (joint) formed where two pieces of material (usually sheet metal) are overlapped.
<b>Longitudinal Joint</b>	Lengthwise joint along a piece of duct (e.g., the joint running the full length of a snap-together sheet metal duct) [Note: <i>longitudinal</i> means "lengthwise"...in contrast with <i>transverse</i> , which means "across".]
<b>NFPA 90B</b>	Standards governing installation of "Warm Air Heating and Air Conditioning Systems" in one- or two-family dwellings and structures not exceeding 25,000 cu. ft. Provides specifications for the manufacture and installation of rigid metal

	ductwork and references UL 181 regarding factory made air ducts (e.g., flexible ducts). Installations in larger structures are addressed by NFPA 90A.
<b>NFV</b>	Net Free Venting: the net amount of venting area provided by a vent after the effect of mesh and/or louvers has been subtracted from the gross area of the vent.
<b>Perm</b>	A unit of permeance, which refers to how permeable a material is (e.g., how well moisture will pass through a vapor barrier).
<b>Pressure Sensitive Tape</b>	Duct tape with a tacky adhesive coating (e.g., butyl, acrylic, etc.) which will adhere to a surface with the application of pressure (heat not required). Duct tapes used in the CSD-sponsored programs must be listed and marked per UL 181A and 181B standards.
<b>Spillage</b>	In a natural vent open combustion appliance, the outflow of combustion gases from the draft hood and into the atmosphere of the room or area where the appliance is located (the combustion appliance zone, or CAZ). Spillage occurs when drafting through the vent system is inadequate to carry combustion gasses up through the vent pipe and out into the atmosphere. Spillage occurs briefly when combustion first begins in a cold appliance, because cold air in the vent pipe impedes exhaust flow until the system warms up. Continuous spillage may result when the vent pipe is blocked by an obstruction or is improperly constructed (too many elbows, improper slope, inadequate diameter, etc.).
<b>Transverse Joint</b>	The joint formed when two pieces of duct are spliced together (e.g., the joint around the circumference where two round ducts are joined together, and the joint around the perimeter where two rectangular ducts are joined together). [Note: <i>transverse</i> means "across"...in contrast with <i>longitudinal</i> , which means "lengthwise".]
<b>UL 181</b>	UL "Standard for Factory-Made Air Ducts and Connectors"
<b>UL 181A</b>	UL standard for pressure sensitive aluminum tapes, heat activated aluminum tapes, and mastic closure systems for use with rigid fiberglass air ducts.
<b>UL 181B</b>	UL standard for pressure sensitive tapes and mastic closure systems for use with flexible air ducts.
<b>UL Class 0 Duct</b>	Air duct materials having a fire hazard classification of zero (flame spread and smoke developed).



**UL Class 1 Duct**

Air duct materials having a flame-spread rating of not over 25 without evidence of continued progressive combustion and a smoke-developed rating of not over 50.

**UL Classified,  
Labeled, Listed**

**UL Listed** means that UL testing included examination of all foreseeable hazards. **UL Classified** means that UL testing was limited to examination of one potential hazard.

**UL Classified,  
Labeled, Listed  
(continued)**

**UL Labeled** means that a product is either UL Listed or Classified. A product can, however, be "Listed" without involving UL. Other accredited laboratories can test products and certify conformance with established standards. Such products can thus be "listed and labeled" without reference to UL.

# SECTION 1

## CAULKING STANDARDS

### 1. APPROVED MATERIALS

- All Materials
  - Contractor must comply with Proposition 65 requirements.
  - Minimum 3 year warranty.
- Acrylic Caulk
  - Conformance to F.S. TT-S-00230C.
- Latex Sealing Compounds
  - Conformance to ASTM C834.
- Butyl Rubber
  - Conformance to F.S. TT-S-001657.
- Chlorosulfonated Polyethylene
  - Conformance to F.S. TT-S-00230C.
- Elastomeric Joint Sealants
  - Includes Polysulfide, Polyurethane, and Silicone.
  - Conformance to ASTM C920.
- High Temperature Caulk
  - Sealant rated for constant service up to at least 450°F (e.g., RTV red silicone, available for service up to 600°F, such as automotive RTV gasket sealant).
- Foam Sealant
  - Class A, or Class 1 per ASTM E84-89a.
  - Non-expanding

### 2. VISIBLE LOCATIONS

- Caulk shall be:
  - Clear when dry, or color coordinated with surrounding material and existing caulk.
  - Silicone may be applied heatly to a joint between dissimilar materials when required by specification.
  - Polyurethane (paintable) is recommended in visible locations where elastomeric sealant is required.

### 3. INTERIOR LOCATIONS

- Caulk shall be nontoxic and in conformance with Item 8.
- Foam sealant shall not be left exposed. (see 1997 UBC, Section 2602.4)

### 4. EXTERIOR LOCATIONS

- For Masonry, Metal Joints and Joints Between Two Different Materials use:
  - Elastomeric caulk with an elongation rating of at least 200%.
  - Masonry caulk shall be neutral cured (xime).
- Attic and Crawl Space
  - Foam sealant may be left exposed.

- Wood Joints
  - Elastomeric caulk or Butyl.

## **5. MATERIALS FOR HEAT-PRODUCING DEVICES**

- Recessed Lights and Other Heat Producing Devices
  - High temperature sealant shall be used.
  - Vent holes in recessed light canister shall not be sealed.
  - Caulk shall not be applied to decorative trim.

## **6. SURFACE PREPARATION REQUIREMENTS**

- Surface shall be free of:
  - Loose or cracked caulking.
  - Dirt, debris, and oily substances.
  - Moisture, unless allowed by manufacturer's specifications.

## **7. INSTALLATION REQUIREMENTS**

- Manufacturer's instructions shall be followed, with careful attention to:
  - Surface preparation.
  - Application temperature limits.
  - Primer requirements (especially for metal and masonry surfaces).
  - Use of filler material (e.g., backer rod) and/or bond breaker tape.
  - Width and depth of bead.
  - Tooling recommendations.

## **8. WIDTH OF GAP**

- Gap Range
  - Minimum crack width , 1/16"
  - Maximum crack width, 5/8"
- Gaps Up to 3/8"
  - May be caulked with any material approved for the location and type of joint.
- Gaps 7/16" to 5/8"
  - Shall be caulked with silicone, polyurethane, or acrylic latex.
- Gaps 3/8" to 5/8"
  - Shall be filled to within 1/2" of the surface before caulking.
  - Acceptable filler materials include:
    - Closed-cell polyethylene backer rod.
    - Flexible fiberglass.
    - Rope caulk.
- Gaps Over 5/8"
  - Shall not be caulked: repair required.

## **9. FINISHED BEAD**

- All Joints
  - Bead shall be continuous and free of voids and bubbles.
  - All excess caulk shall be removed (e.g., by tooling).
  - Sealants shall be applied/tooled with sufficient pressure to fill the joint completely.

- Butt Joints
  - Bead shall be no deeper than it is wide (i.e. depth controlled with backer material).
    - Gaps wider than 5/8" shall not be caulked.
  - Bead shall be tooled to:
    - Compress sealant against filler material and sides of the joint,
    - Remove excess caulk, and form a concave surface (e.g., create an "hourglass" profile when backer rod is used).
  - When filler material is not used and a bond breaker is recommended by sealant manufacturer, bond breaker tape shall be installed to prevent sealant adhesion to bottom of the joint.
    - Bond breaker may be polyethylene or TFE-fluorocarbon self-adhesive tape.

## **10. POST-INSTALLATION REQUIREMENTS**

- Paint dust and chips, scraps, and other debris resulting from weatherization activities shall be cleaned up and removed from the premises utilizing lead-safe practices when applicable.
- Furniture and other household items moved for weatherization work shall be returned to normal.

## SECTION 2

### WEATHERSTRIPPING STANDARDS

#### 1. APPROVED MATERIALS

- Rigid Gasket (Aluminum Carrier)
  - Solid Extruded aluminum carrier 0.05" thick, minimum.
  - Pliable gasket of vinyl or silicone.
  - Carrier shall have elongated mounting holes, 9" OC maximum.
  - Secondary seal between carrier and mounting surface shall be a minimum of 3/8" wide and extend the full length of the carrier.
  - Minimum elongation of 300% for vinyl, 310% for silicone.
- Spring and Cushion Metal
  - Brass, bronze, or stainless steel only; aluminum not allowed.
- Cushion Synthetic
  - Polypropylene
  - L-shaped stabilizer with self-adhesive backing.
- Flanged Bulb
  - Pliable gasket of TPE or silicone.
  - Minimum 3/8" wide with self-adhesive stabilizer flange.
- Foam Tape
  - Shall be used only in compression applications not allowed where shear/friction movement occurs.
  - Closed Cell Foam Tape
    - Shall be UV-resistant with self-adhesive backing.
    - Uses include sealing entrance doors with metal jambs.
  - Open Cell Foam Tape
    - Shall have self-adhesive backing.
    - Uses include sealing cooler vent covers and attic/crawlspace access covers.
- Replacement Pile
  - Properly sized for retaining channel; fin seal recommended.
- Corner Pads
  - Pile pad with self-adhesive backing.
- Mechanical Attachments
  - All screws, nails, staples, etc. shall be noncorrosive.
- Pressure-Sensitive Adhesive
  - Minimum adhesion strength of 65 oz./in.
  - Required on all self-adhesive products.
- Door Shoe, Automatic Door Bottom, Stationary Sweep, Metal Saddle Threshold, and Bumper Threshold
  - Solid aluminum Extrusions 6063-T5 alloy.
  - Gaskets: Pliable vinyl, TPE, silicone, or equivalent.
- All Door Shoes, Door Bottoms, and Sweeps

- Solid aluminum carrier 0.05" nominal thickness or greater, with elongated mounting holes 9" OC maximum.
- Automatic Door Bottom
  - Retractable type only flip sweep not allowed.
- Stationary Sweep
  - Pliable gasket of vinyl, silicone, or equivalent attached to an extruded aluminum carrier.
  - Shall have elongated mounting holes, 9" OC maximum.
- Metal Saddle Threshold
  - All-aluminum only; "gasket saddle" with vinyl top gasket not allowed.
  - Shall have floor-sealer gasket of vinyl, TPE, silicone, or equivalent.
- Wooden Saddle Threshold
  - Hardwood only; "gasket saddle" with vinyl top gasket not allowed.
- Bumper Threshold
  - Solid aluminum extension with gasket of vinyl or silicone.

## **2. WARRANTY**

- Minimum 3 year warranty required on all materials.

## **3. SLIDING GLASS DOORS**

- Doors shall be weatherstripped with:
  - Replacement pile
  - Closed cell foam in compression only.

## **4. PLACEMENT**

- Weatherstripping shall be placed only at moveable joins on doors between conditioned and unconditioned space.
- Weatherstripping shall be installed and adjusted to provide a continuous barrier to infiltration along its entire length.
- Doors shall function properly and close without unusual force after weatherstripping is installed.

## **5. HORIZONTAL ALUMINUM SLIDING WINDOWS AND GLASS DOORS**

- Materials Allowed:
  - Replacement Pile.
  - Cushion Synthetic.
  - Flanged Bulb.
  - Closed Cell Foam.
  - Vinyl V-Strip

## **6. ENTRANCE DOOR JAMBS**

- Materials for Wooden Door Jambs
  - Rigid gasket.
  - Spring or Cushion Metal.
- Materials for Metal Door Jambs

- Rigid Gasket.
- Cushion Synthetic.
- Flanged Bulb.
- Closed Cell Foam.
- Metal or Wooden Jamb with Fire Rating Over 20 Minutes
  - Shall not be weatherstripped.

## **7. ENTRANCE DOUBLE DOORS**

- Astragal Weatherstripping Materials
  - Rigid Gasket.
  - Spring or Cushion Metal.
  - Cushion Synthetic.
  - Flanged Bulb.
  - Closed Cell Foam.

## **8. EXISTING WEATHERSTRIPPING**

- Doors With Factory-Installed Weatherstripping
  - Includes Interlock and Kerf-in Bulb and Magnetic Types.
  - Removal of existing weatherstripping not required if existing material does not interfere with proper operation of the door and the new weatherstripping, and the new Program Policy & Procedure does not specify removal of such material.
  - Retrofit weatherstripping shall be added, as needed, to complete a proper seal around the door.
- All Other Doors
  - Retrofit weatherstripping shall not be added until faulty weather-stripping is removed.
  - Paint dust and chips and other debris resulting from removal shall be cleaned up and removed from premises.

## **9. SAFETY PRACTICES**

- When metal stock is cut or trimmed:
  - Burs shall be removed.
  - Sharp edges and ends (e.g., on rain drips) shall be rounded and smoothed.
- Lead-safe weatherization practices shall be employed when working with pre-1979 painted materials.
- All functional locks shall latch properly.

## **10. ATTACHMENT**

- All Types
  - Manufacturer's instructions shall be followed.
- Rigid Gasket
  - Shall be adjustable and attached with screws located within 3" of each end and at intervals not exceeding 9".
- Shoes and Sweeps
  - Shall be adjustable and attached with screws located within 3" of each end and at intervals not exceeding 9".

- Spring and Cushion Metal
  - Mechanical attachments (e.g., 1/4" x 3/8" staples) shall be placed within 1" of each end and at intervals not exceeding 4".
- Cushion Synthetic, Compression Bulb, and Foam Tape.
  - Mounting surface shall be thoroughly cleaned.
  - Existing adhesive residue shall be removed with solvent.
- Corner Pads
  - Adhesive backing shall be supplemented with staples, tacks, etc. that penetrate wood 3/8" minimum.
- Replacement pile
  - Shall fit snugly into retaining channel.
- Mechanical Attachment
  - Door Shoes and Sweeps
    - Must be attached with screws
    - Only metal pan head Phillips screws, with a head diameter no larger than 2 times the elongated opening of the aluminum carrier.
    - Manufacturers supplied Phillips screws may be used
- All screws, nails, staples and all other fasteners shall be non-corrosive and properly sized for all applications.

## 11. DOOR JAMB WEATHERSTRIPPING INSTALLATION

- All Materials
  - Corners and joints shall be trimmed to provide a continuous barrier to infiltration without gaps between adjoining legs.
- Rigid Gasket
  - Screws shall be positioned to allow for adjustment of carrier.
  - Each leg shall be one continuous strip.
  - Gasket-to-gasket contact required at joints.
- Spring and Cushion Metal, and Cushion Synthetic.
  - Sealing surfaces shall be mitered at the corners.
  - Ends shall be overlapped when possible to provide a seal when compressed.
- Foam Tape and Flanged Bulb
  - Material shall be joined at corners; miter joint recommended.

## 12. THRESHOLD INSTALLATION

- All Thresholds
  - Shall be installed full length; splicing not allowed.
  - Shall extend above the interior finished floor a maximum of 1<sup>or</sup> 3/8" if any occupant is physically handicapped.
  - Ends of threshold shall be cut to match the contour of the jamb (i.e., notched to fit snugly around jamb, stop, trim, etc.).
  - The perimeter shall be sealed (e.g., by caulking the ends and, where applicable, the front and back edges).
- Metal Thresholds



- Saddle threshold shall have floor-sealer gaskets in place.
- A bumper threshold may be used on outswinging door for which a threshold-and-shoe combination cannot be feasibly installed (e.g., when closed door does not cover floor surface).
- Threshold shall be permanently screwed in place.
- Wooden Saddle Thresholds
  - Threshold shall be sealed to the floor with glueor elastomeric caulk,or floor-sealer gasketing.
  - Threshold shall be mechanically fastened with nails or screws.
- Low-Profile Thresholds
  - Interior-Located Doors Without Existing Threshold
    - Threshold with maximum 1/4" height ("low-profile" aluminum threshold) may be installed in the following locations:
      - At a step-down from the living space to an unconditioned area (e.g., kitchen to garage).
      - On a floor continuing flat into an unconditioned area (e.g., from kitchen into utility room or, in an apartment complex, from the living area into an unheated common hallway).

### 13. THRESHOLD RISERS

- All Thresholds
  - A riser may be installed on top of an existing threshold when no other treatment is feasible.
    - Only a commercially available riser compatible with the threshold shall be used.
    - Riser shall be installed full length; splicingnot allowed.
  - Top of riser shall extend above the interior finished floor a maximum of 1", or 3/8" if any occupant is physically handicapped.
  - Riser shall be securely attached with countersunk screws.
- Metal Thresholds
  - Metal risers shall be used.
- Wooden Thresholds
  - Hardwood risers shall be used.

### 14. ENTRANCE DOOR BOTTOM INSTALLATIONS

- Shoe-and-Saddle-Threshold Combination
  - Shoe-and-saddle combination shall be used where possible.
  - L-shoe may be installed only where U-shoe can be installed (e.g., non-standard doorthickness or metal-clad door.).
  - Rain drip required on shoes in exposed exterior locations.
- Stationary Sweeps
  - Allowed only when no other door bottom treatment is feasible.
  - Sweep shall seal along the entire length of the gasket.
  - In-Swinging Doors
    - Sweeps shall be installed on the interior side of an exposed exterior door.

- Out-Swinging Doors in Sheltered Locations (e.g., Inside Garage)
  - Sweeps shall seal against a threshold or other vertical surface (e.g., stair nosing).
  - Sweep may be installed on the outward side of the door.
- Retractable Sweeps (Automatic Door Bottoms)
  - An automatic door bottom shall be installed only when:
    - There is no threshold over the finished floor and/or
    - A shoe-and-saddle combination is not feasible.
  - Sweep shall seal against floor or existing threshold along entire length of gasket.
  - Ends of gasket shall be trimmed long enough to extend from jamb to jamb when door is closed.
  - Unit shall be attached securely with screws that penetrate solid wood.
- All Door Bottoms
  - Weatherstripping material shall not drag on the floor covering (wood, tile, carpet, etc.).
  - Unit shall be installed full length; splicing not allowed.

## 15. APPLIANCE ENCLOSURE DOORS

- Weatherstripping shall be installed as needed to isolate the enclosure from the living space.
- Weatherstripping shall not be installed if:
  - The appliance requires air from conditioned space (i.e., door or wall contains one or more combustion air vents) or
  - Combustion air being supplied to the appliance is not adequate (see Appendix D).
- Jamb Materials
  - Rigid Gasket, Spring and Cushion Metal, Cushion Synthetic, Flanged Bulb, or Closed Cell Foam Tape.

## 16. ATTIC AND CRAWLSPACE ACCESS DOORS

- Location
  - Doors accessed from conditioned space.
- Materials
  - Horizontal Access Doors
    - Open cell foam.
    - Closed Cell Foam and Flanged Bulb acceptable if thickness does not create more than 3/16" gap between door and retaining surface.
  - Vertical Access Doors (i.e., Knee Wall Door)
    - Materials approved for entrance doors shall be used.
- Mounting Surface
  - Weatherstripping shall be installed on surface providing best adhesion (i.e., smooth wood trim rather than textured drywall lid).
  - Mounting surface shall be free of dust, dirt, and debris.

## **17. POST-INSTALLATION REQUIREMENTS**

- Paint dust and chips, scraps, and other debris resulting from weatherstripping installation shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
- Furniture and other household items moved for weatherization work shall be returned to normal.

## SECTION 3

### CEILING INSULATION STANDARDS

#### 1. APPROVED MATERIALS

- Mineral Fiber
  - Flexible (Batts): Conformance to ASTM C665.
  - Roof Board: Conformance to ASTM C726.
  - Loose Fill: Conformance to ASTM C764.
- Mineral Cellular
  - Vermiculite: Conformance to ASTM C516.
  - Perlite: Conformance to ASTM C549.
- Cellulose
  - Loose Fill
    - Licensed for sale in California.
    - Compliance with CPSC CFR, Parts 1209 and 1404, and ASTM C739.
- Rigid
  - Preformed Polyisocyanurate Board Foil Faced on Both Sides
    - Conformance to FS HH-1-1972/1.
  - High Density Fiberglass Board: Conformance to ASTM C726.

#### 2. R-VALUES

- Per Program Policies and/or Procedures and Contract.

#### 3. LOCATION

- All Insulation
  - Insulation shall be installed only between conditioned and unconditioned areas.

#### 4. STRUCTURAL REQUIREMENTS

- All Insulation
  - Ceiling shall be structurally adequate to support weight of installer and installed insulation.
  - Ceiling insulation shall not be installed when roof leaks are present.

#### 5. VAPOR BARRIER

- Not Required
  - If installed, must be directly on attic floor and facing the living area.
- All Insulation
  - Vapor barrier shall not be installed over existing insulation.
  - When installed, vapor barrier shall be:
    - Placed toward winter warm side.
    - Rated no higher than 1 perm.
  - When existing batts are incorrectly installed with vapor barrier on top (upward):

- Vapor barrier shall be removed from attic, or
- Batts shall be turned over to place facing against attic floor, or
- Vapor barrier shall be slashed entire length of batt or across the width of the batt at 12" intervals.
- Vapor barrier recommended

## 6. ELECTRICAL WIRING

- All Insulating Materials
  - Insulation shall not be installed over bare wires or wires with frayed or decayed insulation.
- Loose Fill
  - Open Junction Boxes
    - Loose fill material shall not cover open junction boxes.
    - Boxes shall be protected with either of the following:
      - Standard cover plates.
      - A minimum 14½" x 12" piece of unfaced batt that covers the box and equals or exceeds height of installed loose fill.
  - Wire Connections Protruding from Junction box
    - Loose fill material shall not cover the wires.
    - Connections shall be protected with either of the following:
      - Box extension and standard cover plate.
      - Mineral fiber blocking which exceeds height of loose fill by 4" and extends away at least 14½" in all directions.
  - Wire Connections Without Junction Box (Spider Web)
    - Wire connections shall not be covered by loose fill material.
    - Connections shall be protected with mineral fiber blocking which exceeds height of loose fill by 4" and extends away at least 14½" in all directions.
  - Knob and Tube Wiring
    - Insulation shall be installed as prescribed in item 31.

## 7. VENTING

- All Insulation
  - For ceiling insulation to be installed, venting shall comply with program policy or the following criteria.
- Venting Criteria
  - Cross ventilation shall be present in each space.
  - 1 sq. ft. of Net Free Venting (NFV) area required per 150 sq. ft. of ceiling area.
  - 1 sq. ft. to 300 sq. ft. ratio is acceptable if:

- Vapor barrier placed toward the winter warm side is present, or
- 50% of the venting is upper venting (25%), with upper vents located at least 3' above the low vents, and low vents are eave or soffit venting.

## 8. KITCHEN AND BATH TYPE EXHAUST SYSTEMS

- Bath type exhaust fans shall be blocked per Item 15.
- Vent Hose/Tube
  - May be covered by loose fill.
  - Shall be cleared of any loose fill.
  - Shall be unobstructed at its termination (open end).
  - Screened openings shall be blocked per Item 20.
- Vent Termination
  - Exhaust systems which terminate in the attic shall be extended to the exterior.
    - The vent pipe shall:
      - Be connected to a roof or wall termination.
      - Have an upward slope (flat run not allowed).
      - Conform to local codes.

## 9. PERMANENT BLOCKING

- Blocking Materials
  - Batts
    - Flexible mineral fiber kraft faced or unfaced.
  - Metal
    - Corrosion-resistant metal, minimum 0.007" thick.
    - Blocking shall be mechanically attached to ceiling and/or framing (e.g., with staples, nails, or screws).
  - Eave Vent Chutes and Baffles
    - Commercially available plastic chutes and cardboard baffles, or 0.007" metal.
    - Maximum flame –spread index of 25 and smoke-developed index of 50, per ASTM E84-89a, UL723, or NFPA 255.
  - Structural Wood
    - Framing members and attached sheathing (e.g., plywood).
- Blocking for Loose Fill Insulation
  - A barrier (blocking and/or structural wood) shall extend from the attic floor to the prescribed height above installed loose fill.
  - Blocking height may be achieved with a combination of structural wood and permanent blocking material.
  - Unfaced and kraft faced flexible blocking may rest on top of other insulation, with vapor barrier facing either up or down.
- Flexible Insulation
  - No blocking required where loose fill is not present.
  - When flexible is being installed over loose fill, blocking/barrier shall prevent loose fill from entering clearance zone.

- Clearance Zone
  - Clearance zone shall provide a cleared space free of insulation that surrounds a heat producing device, vent, etc.
  - Clearance from blocking to protected item shall be a minimum of 3" but no greater than necessary to provide proper blocking.
  - After insulation has been installed, the clearance zone shall be free of loose fill material.

## **10. TEMPORARY BLOCKING COVER**

- Loose Fill
  - A temporary cover may be placed over permanent blocking to prevent accidental "overblow" of loose fill into clearance zone. The cover shall be removed after insulating.

## **11. RECESSED LIGHTING FIXTURES**

- Loose Fill
  - 3" clearance zone required around fixture.
  - Noncombustible blocking required.
  - Blocking in conformance with Item 9 shall rest on attic floor and exceed height of loose fill by 4".
  - Metal blocking material must be at least .007" thick.
  - Metal blocking must be permanently attached to ceiling joist: stapled, nailed, or screwed.
  - Flexible mineral fiber blocking shall extend at least 14½" away from the clearance zone in all directions.
  - If covered, 24" minimum top clearance required.
  - Gypsum enclosures which house recessed fluorescent light fixtures do not require protection from loose fill.
  - Existing wood framing members acceptable as barriers if they exceed the height of the insulation by 4".
- Flexible
  - 3" clearance from fixture required on all sides.

## **12. TYPE IC (INSULATED CEILINGS) RECESSED LIGHTING FIXTURES**

- Must meet same clearance as any recessed lighting fixture.

## **13. RECESSED INTERIOR SOFFITS CONTAINING HPDs**

- Loose Fill
  - Soffits shall be blocked to protect recessed lights and other heat producing devices.
    - Blocking in conformance with item 9 shall:
      - Extend from the attic floor to 4" above the loose fill.
      - Extend at least 14½" back from the soffit opening when mineral fiber blocking is used.
      - Blocking inside soffit shall be installed in conformance with Items 11 and 12 of this section.

- Accessible knee walls (12" or higher) shall be insulated in conformance with Item 30 of this section.

#### **14. DOORBELL TRANSFORMER**

- Loose Fill
  - 3" clearance zone required around transformer.
  - Noncombustible blocking required.
  - Blocking shall conform with item 9, rest on attic floor and exceed height of loose fill by 4".
  - Metal blocking must be permanently attached to ceiling joist: stapled, nailed, or screwed.
  - Flexible mineral fiber blocking shall extend at least 14½" away from clearance zone in all directions.
  - If covered, 24" minimum top clearance required.
  - Blocking not required if transformer is mounted above top of insulation.
- Flexible
  - 3" clearance from transformer required on all sides.

#### **15. FAN MOTORS & MISC. HPDs, INCLUDING EXPOSED FLUORESCENT FIXTURES**

- HPD's include, but not limited to, the following:
  - Recessed light fixtures
  - Doorbell transformers (DBT)
  - Fan motors
  - Metal flues
  - Masonry chimneys
  - Other heat producing devices
- Loose Fill
  - 3" clearance zone required around heat producing device (HPD).
  - Noncombustible blocking required.
  - Blocking in conformance with Item 9 shall exceed height of loose fill by 4".
  - Flexible mineral fiber blocking shall extend at least 14½" away from clearance zone in all directions (as illustrated in Item 17).
  - When cover/insulation is placed above an HPD, cover/insulation shall be at least 24" above the HPD.
- Flexible
  - 3" clearance from HPD required on all sides.
- Abandoned Vent Pipes
  - Must be blocked

#### **16. WHOLE-HOUSE FANS**

- Loose Fill
  - Blocking required, even when a shroud is present on the fan.
  - 3" clearance zone required for fan motor.
  - Blocking, in conformance with item 9, shall rest on attic floor and exceed height of insulation by 4".



- Flexible mineral fiber blocking shall extend at least 14½" away from clearance zone in all directions.
- Flexible
  - 3" clearance required for fan motor.

## **17. GAS AND SOLID FUEL VENT AND FLUE PIPES AND MASONRY CHIMNEYS**

- Loose Fill
  - 3" clearance zone required around HPD.
  - Noncombustible blocking required.
  - Blocking, in conformance with item 9, shall rest on attic floor and exceed height of insulation by 4".
  - Flexible mineral fiber blocking shall extend at least 14½" away from clearance zone in all directions.
- Flexible and Rigid
  - 3" clearance from HPD required on all sides.
- Abandoned Pipes
  - Shall be blocked.

## **18. FURNACES AND HEAT PUMPS LOCATED IN ATTICS**

- Loose Fill
  - A clearance zone is required around all units.
    - 12" clearance around back, sides, and top.
    - 24" clearance in front.
    - 3" clearance for flues pipes.
  - Blocking shall conform to item 9.
  - Blocking required unless bottom of unit is more than 4" above loose fill.
  - Blocking shall rest on the attic floor and exceed height of loose fill by 4".
  - Flexible mineral fiber blocking shall extend at least 14½" away from clearance zone in all directions.
  - "Overblow" shall be cleared from unit and clearance zone.
  - If unit is suspended or draws combustion air from the bottom:
    - 12" clearance shall be provided below unit, or
    - Flexible insulation shall be installed below which extends 12" beyond unit on all sides (no exposed loose fill beneath unit).
- Flexible
  - 12" clearance required on all sides; 3" clearance for flue pipes.
  - 6" clearance below units drawing combustion air from bottom.
- Platforms and Catwalks
  - Insulation shall be installed underneath both when accessible.
  - Insulation shall not be installed on top of platforms.

## **19. WATER HEATER LOCATED IN ATTIC**

### Electric Units

- Loose Fill
  - 3" clearance zone required around unit.
  - Blocking required if bottom of unit is below top of installed loose fill.

- Blocking shall be noncombustible, confirm to item 9, and equal or exceed height of insulation.
- Flexible mineral fiber blocking shall extend at least 14½" away from clearance zone in all directions.
- Insulation "overblow" shall be cleared from unit, clearance zone, and platform.
- Flexible
  - 3" clearance from unit required on all sides.

### Gas Units

- Loose Fill
  - A clearance zone is required around the unit.
    - 6" clearance around sides and back.
    - 12" clearance in front.
    - 3" clearance for flues.
  - Blocking required if bottom of unit is not at least 4" above installed loose fill.
  - Blocking material shall be noncombustible and exceed height of loose fill by 4".
  - Flexible mineral fiber blocking shall extend at least 14½" away from clearance zone in all directions.
  - Insulation "overblow" shall be cleared from unit, clearance zone, and platform.
- Flexible
  - 6" clearance from unit required on all sides.
  - 3" clearance required for flues.

## **20. COMBUSTION AIR SUPPLY**

- Loose Fill
  - Blocking required.
  - Must not obstruct air supply.
  - Blocking shall confirm to item 9, rest on the attic floor, and exceed height of loose fill by 4".
  - Flexible mineral fiber blocking shall extend at least 14½" away from vent opening in all directions.
  - Any insulation which blocks the screen shall be removed.
  - Blocking may be either flexible fiberglass batts or metal barriers.
- Flexible
  - Must not obstruct air supply.

## **21. CLOSET OPENINGS**

- All Insulation
  - Combustion air supply
    - When closet opening is used for combustion air supply, it shall be blocked.
    - Blocked as specified in Item 20 of this section.
  - Ceiling vents not used for combustion air

- The opening shall be sealed.
- The ceiling shall be insulated.
- Vents shall be sealed with gypsum, or plywood (minimum ½" thick) or 5/8" wood.
- Gypsum & plywood shall be sealed in place.
- Vents shall not be sealed with mineral fiber batts or foam board.

## **22. ATTIC ACCESS DOOR BLOCKING**

- Loose Fill
  - Each access must be blocked.
  - Blocking shall be confirm to item 9, and extend from the attic floor to the top of the installed loose fill.
    - Flexible mineral fiber batts shall extend at least 14½" away from access opening in all directions.
    - Metal barrier material shall not be installed.
  - 2-by joists and other wood members:
    - Where wood extends from attic floor to top of installed loose fill, additional blocking is not required.
    - Where wood extends from attic floor but does not equal height of installed loose fill, blocking shall be added.
      - Mineral fiber batt may be used in combination with wood members to achieve required height.
      - Unfaced batt may be placed on top of existing loose fill.
    - Where wood is not present, flexible mineral fiber blocking shall rest on the attic floor.
- Flexible
  - Blocking is required only where unblocked loose fill is present at the access opening.

## **23. ATTIC ACCESS DOOR INSULATION**

- All Insulation
  - All attic entry doors accessed from conditioned space shall be insulated:
    - Minimum R-19 shall be installed on horizontal doors.
    - Minimum R-11 shall be installed on vertical doors.
    - Rigid or flexible insulation shall be used.
    - Insulation shall be permanently attached.
  - Multiple Accesses
    - All applicable attic entry doors shall be insulated.

## **24. ATTIC ACCESS DOOR WEATHERSTRIPPING**

- All Insulation
  - Only attic entry doors accessed from conditioned space shall be weatherstripped.
  - Horizontal doors

- Open cell foam is standard.
- Closed cell foam acceptable if thickness does not create more than 3/16" gap between door and retaining surface.
- Mounting Surface
  - Weatherstripping shall be installed on surface providing best adhesion (i.e., smooth wood trim rather than textured drywall door).
  - Mounting surface shall be free of dust, dirt and debris.
- Vertical doors
  - Materials approved for entry doors shall be used (see Section 6).

## **25. DISAPPEARING STAIRS**

- All Insulation
  - Lid shall be weatherstripped
  - Lid shall be insulated with minimum R-19 rigid or flexible insulation material.
  - Hinged lid shall be installed if not already present
  - Insulation shall be permanently attached to lid
- Loose Fill
  - Blocking shall conform to item 9 and be installed as prescribed in Item 22.
  - Bottom door shall be weatherstripped as prescribed in Item 24.
- Flexible
  - Bottom door shall be weatherstripped.
- Stairs with top lids
  - Top lid shall be insulated as prescribed in Item 23.
  - Blocking shall be installed as prescribed in Item 22.
  - Top lid shall be weatherstripped as prescribed in Item 24.

## **26. OPEN END CAVITIES**

- Loose Fill
  - Blocking shall be installed to prevent loose fill from spilling out the open end of the joist cavity.
  - Blocking shall conform to item 9 and rest on the top plate and exceed the height of loose fill by 4".
  - Metal, noncombustible cardboard chute/barrier material or flexible insulation may be used.
  - Flexible insulation shall extend at least 14½" back from the open end of the cavity.

## **27. EAVE AND SOFFIT VENTS**

- Flexible
  - Minimum 2½" clearance required between roof sheathing and insulation.
- Loose Fill
  - Blocking shall be installed which extends to the top plate (i.e., batt, chute, baffle, etc.).
  - Minimum 2½" clearance required between roof sheathing and blocking.
  - Vent screens shall be free of loose fill.

- Horizontal Mineral Fiber Blocking
  - May rest on existing loose fill provided no loose fill is exposed at the top plate.
  - Blocking which extends inward 14½" shall exceed height of the loose fill by 4".
  - Blocking which extends inward 24" shall equal or exceed height of the loose fill.
- Restricted Access
  - Flexible mineral fiber blocking shall be installed.
  - Minimum 2½" clearance between blocking and roof sheathing.
  - Minimum 2½" air path between vent and blocking.
  - Blocking
    - May be placed over existing loose fill if unfaced batt is used and loose fill is not blocking vent.
    - Shall exceed height of loose fill or extend inward at least 24".
- Restricted Access (HPD Present)
  - Applies when HPD is less than 18" from an eave/soffit vent and clearance between floor joists and rafters is less than 14" at edge of clearance zone (as illustrated below).
    - Clearance zone shall be free of loose fill.
    - Minimum 3" clearance required between HPD and blocking.
    - Between joists adjacent to the HPD, flexible mineral fiber blocking shall be installed which rests on the attic floor, extends inward at least 14½", and or exceeds height of the installed loose fill by 4".
    - Along the outside of each joist adjacent to the HPD, flexible mineral fiber blocking shall be installed (may rest on existing loose fill) which extends away from the clearance zone at least 14½" and or exceeds height of installed loose fill by 4".
- Baffles and chutes attached to rafters shall:
  - Rest on the top plate and extend above the loose fill by a minimum of 4" and a maximum of 12".
  - Be permanently attached with a minimum of two mechanical fasteners per rafter.
- Baffles and chutes may be made of:
  - Preformed plastic, commercially available.
  - Precut cardboard, commercially available.
  - Minimum .007" metal.
  - Plywood, gypsum, or equivalent building materials.
- Preformed Ventilation Chutes
  - Molded rigid plastic or equivalent.
  - Minimum air path:

- 2" x 12" for 16" OC rafters.
- 2" X 18" for 24" OC rafters.
- Chutes shall:
  - Rest on top plate and extend above the loose fill by a minimum of 4" and a maximum of 12".
  - Be permanently attached at the top with at least one mechanical fastener on each side.
  - Be installed in a manner which prevents new loose fill from blowing around the bottom and edges.

## **28. CONTINUOUS SOFFIT VENTS**

- All Loose Fill
  - Blocking must be installed.
  - Blocking must conform to item 9.
  - Mineral fiber blocking must rest on the attic floor and extend 15" from the top plate.
  - Minimum 3" clearance between blocking and roof sheathing.
  - Vent chutes must be non-combustible.
  - Vent chutes must extend above the installed loose fill.
  - All nonmetal chutes must be kept 12" away from heat producing devices.
- Flexible
  - Minimum 3" clearance required between roof sheathing and insulation.
- All Types
  - Loose fill that falls on the vent screen must be removed.

## **29. BALLOON FRAMING**

- Loose Fill
  - Blocking shall be installed to prevent loose fill from falling down into open wall cavities and crawl space or basement.
  - Block must conform to item 9.

## **30. KNEE WALLS AND PARTIAL CATHEDRAL CEILING COMBINATIONS**

- Knee Walls & Skylight Wells
  - Uninsulated knee wall areas over 12" in height after new insulation is installed shall be insulated.
  - Minimum R-Value
    - R-11 if framed with 2" x 4" studs.
    - R-19 if framed with 2" x 6" studs.
- Partial Cathedral Ceiling and Knee Wall Combinations
  - Mineral fiber batt may be installed in partial vaulted ceiling cavities.
  - Minimum 1" air space required between batt and roof sheathing.
  - Loose fill not allowed.

## **31. KNOB-AND-TUBE WIRING**

- All Insulation
  - Attic with knob-and-tube wiring shall not be insulated unless the wiring has been surveyed by an electrical contractor and certified to be:

- Live and acceptable for encapsulation.
- Abandoned and disconnected.
- All provisions of this section and Article 324, Section 324-4 of the 1998 California Electrical Code shall be met.
- Certification of Wiring by Electrical Contractor
  - Certification shall be provided by a C-10 electrical contractor licensed by the State of California.
  - The electrical contractor shall survey all knob-and-tube wiring located in all areas to be insulated and shall complete a “Notice of Survey by Electrical Contractor” prior to installation of ceiling insulation.
  - A copy of the “Notice of Survey by Electrical Contractor” shall be provided to the local jurisdiction and the property owner when insulation is installed.
- Live Knob-and-Tube Wiring
  - Attics with knob-and-tube wiring may be installed if:
    - The knob-and-tube wiring is certified to be acceptable for encapsulation, i.e., in good condition with no evidence of deterioration or improper overcurrent protection and no improper connections or splices.
    - The knob-and-tube wiring, initially found to be in poor condition, has been upgraded to be acceptable for encapsulation.
  - Insulation which encapsulates live knob-and-tube wiring shall be installed when the wiring was found to be in poor condition and will be upgraded to be acceptable for encapsulation.
  - Installation of New Overcurrent Protection
    - The devices shall be a tamperproof type (e.g., Type “S” fuses or circuit breakers).
    - Prior to installation of such devices, the occupant must sign a statement in the “Notice of Survey by Electrical Contractor” acknowledging that he/she understands that existing usage of electrical appliances may cause nuisance tripping of the new overcurrent protection devices.
  - The following requirements apply to all attics insulated:
    - Insulation shall be noncombustible, as defined in Section 215 of the 1998 California Building Code.
    - Barriers and supports shall be noncombustible and shall not contain any electrical conductive material.
    - A “Warning Placard”, stating that caution is required when entering insulated areas because of covered electrical wiring, shall be posted inside the attic near each openable entrance in a location where it will be observed by persons entering the attic.
    - A copy of the completed “Notice of Survey by Electrical Contractor” shall be posted near the “Warning Placard” at the primary entrance.
- Abandoned and Disconnected Knob-and-Tube Wiring
  - Prior to installation of ceiling insulation that encapsulates knob-and-tube wiring, the wiring shall be surveyed by an electrical contractor.

- The “Notice of Survey by Electrical Contractor” shall specify that all knob-and-tube wiring located in all areas to be insulated not live and has been abandoned and disconnected.
- The electrical contractor, by severing wires in the attic or by other means, shall ensure that all abandoned and disconnected wiring cannot be energized by reconnecting abandoned feeder conductors to a service panel or other power source.



## SECTION 4

### ATTIC VENTILATION STANDARDS

#### 1. APPROVED MATERIALS

- Wood
  - Shall be constructed of treated stock or redwood.
  - Shall be installed only in gable applications.
- Metal
  - Galvanized sheet metal or aluminum.
- Plastic
  - Shall be UV resistant.

#### 2. MESH

- Required on all vents except turbines.
- Mesh must be made of corrosion-resistant metal only. Openings in mesh must be between 1/8" to 1/4".
- Wire only; nonmetallic not allowed.
- Any existing vents that is missing mesh or has tears greater than 1" in mesh, must have new mesh installed.

#### 3. TURBINE VENTILATORS

- Shall be constructed of galvanized sheet metal or aluminum.
- Shall have sealed steel bearings.
- Shall be internally or externally braced.
- Not allowed as low vents.
- Not allowed when roof slope is less than 2 and 12.

#### 4. ROOF JACKS

- Vents shall be constructed of galvanized sheet metal or aluminum.
- Roof Jacks (dormer vents, etc.)
  - Includes dormer, eyebrow, mushroom, and hood vents.
  - Not allowed for low vents when eave or soffit vents can be installed.
  - Not allowed when roof slope is less than 2 and 12.

#### 5. LOUVERS

- Louvers shall be present on vents exposed to precipitation.
- Vertical Vents
  - Louvers shall be angled downward.
- Horizontal Vents
  - Louvers shall be directed toward the wall.

#### 6. INSULATION PRECAUTIONS

- Vents Adjacent to Insulation (e.g., Eave and Soffit Vents, and Gable Vents and Roof Jacks Used for Lower Venting)
  - Insulation shall not obstruct or hamper proper operation of vents.
- Loose Fill Insulation

- Blocking shall be installed as prescribed in Section 7.
- Flexible Insulation
  - A 2-1/2" clearance (air path) required between insulation and the:
    - roof sheathing.
    - vent opening.

## 7. AMOUNT OF VENTING

- Venting Requirement
  - When ceiling insulation is installed, venting shall comply with program policy or the following criteria.
- Venting Criteria
  - Cross ventilation for each separate space is required.
  - 1 sq. ft. of Net Free Venting (NFV) area required per 150 sq. ft. of ceiling area.
  - 1 sq. ft. to 300 sq. ft. ratio is acceptable if:
    - Vapor barrier placed toward the winter warm side is present, or
    - 50% of the venting is upper venting ( $\pm 25\%$ ), with upper vents located at least 3' higher than low vents, and low vents are eave or soffit venting.
  - Appendix E shall be used to calculate NFV for existing and installed vents.

## 8. PLACEMENT AND INSTALLATION

- All Vents
  - Placement and installation shall be in conformance with manufacturer's instructions and applicable codes.
- Eave and Soffit Vents
  - Unless replacing an existing vent, eave and soffit vents shall not be installed above an operable window when prohibited by local jurisdiction.
- Gable Vents
  - Shall be installed in the upper 1/3 of the gable wall when used as high vents.
  - May be installed in the lower 1/3 of an unvented gable wall to provide low venting.
    - Blocking for loose fill insulation shall be installed as prescribed in Section 7.

## 8. PLACEMENT AND INSTALLATION

- Turbine Ventilators
  - Shall be installed between rafters.
  - Top of turbine shall not be below roof apex.
  - At least 2/3 of the upper base flange shall be secured underneath roofing material.
  - Turbine ventilators shall not be installed:
    - as low vents.
    - on roofs with a slope of less than 2-in-12.

- Roof Jacks (Static Vents with Flanged Base)
  - Shall be installed between rafters.
  - At least 2/3 of the upper base flange shall be secured underneath roofing material.
  - Shall not be installed on roofs with a slope of less than 2-in-12.

## 9. HIGH VENTS

- The following may be used as high vents:
  - Gable Vents
  - Roof Jacks (e.g., Eyebrow, Dormer, Mushroom and Hood).
  - Wind Turbines.
  - Ridge Vents.

## 10. LOW VENTS

- Eave and soffit vents shall be used when possible.
- When eave or soffit vents cannot be installed:
  - Eyebrow or dormer vents may be mounted low on the roof.
  - Gable vents may be mounted low on an unvented gable wall.

## 11. EXISTING MESH

- Existing mesh shall be cleaned or replaced with 1/4" mesh if opening is clogged.
- Removal of 1/16" insect screen and replacement with 1/4" mesh recommended.

## SECTION 5

### DUCT REPAIR STANDARDS

#### APPROVED MATERIALS

#### 1. ALL MATERIALS

- Surface burning characteristics, per UL 723, UL 2043, ASTM E84, or NFPA 255:
  - Flame spread rating not to exceed 25.
  - Smoke developed rating not to exceed 50.
- Only exterior-rated products shall be used on the exterior (doors).

#### 2. DUCT MASTIC

- All Ducts
  - Mastic shall be:
    - Non-toxic and water resistant.
    - UL listed and labeled per UL 181A or 181B standards.
- Flexible Metallic and Nonmetallic Ducts
  - Mastic shall be:
    - UL labeled "181B-M".
    - Compatible with the duct to which it is applied.
- Rigid Metal Ducts and Components
  - Mastic shall be UL labeled "181A-M" or "181B-M".
- Rigid Fiberglass Ducts
  - Mastic shall be labeled "181A-M".

<b>UL 181A APPLIES TO SEALANTS USED ON RIGID FIBERGLASS DUCT BOARD</b>	<b>PRESSURE SENSITIVE TAPE</b>	<b>MARKED "181A-P"</b>
	<b>HEAT ACTIVATED TAPE</b>	<b>MARKED "181A-H"</b>
	<b>MASTIC</b>	<b>LABELED "181A-M"</b>
<b>181B APPLIES TO SEALANTS USED ON FLEXIBLE DUCTS</b>	<b>a) PRESSURE SENSITIVE TAPE</b>	<b>MARKED "181B-FX"</b>
	<b>b) MASTIC</b>	<b>LABELED "181B-M"</b>

#### 3. MESH TAPE

- All Ducts
  - Mesh fabric used to reinforce duct mastic shall:
    - comply with mastic manufacturer's instructions, or
    - meet the following specifications:
      - Fiberglass mesh tape.
      - Weave per inch: 9 x 9 minimum.
      - Thickness: 0.006" minimum.
- Flexible Ducts and Rigid Metal Ducts
  - Mesh tape width: 2" minimum.

- Rigid Fiberglass Ducts
  - Mesh tape width: 3" minimum.

#### 4. HEAT ACTIVATED TAPE

- Rigid Fiberglass Ducts (Only)
  - Tape shall be:
    - UL 181 listed and marked "181A-H".
    - 3" minimum width.

#### 5. PRESSURE SENSITIVE TAPE

- All Ducts
  - Cloth-backed tapes are not allowed.
- Flexible Metallic and Nonmetallic Ducts
  - Tapes shall be UL 181B listed and marked "181B-FX".
  - Metallic tapes with butyl adhesive ("butyl tape") shall be UL listed for sealing flexible nonmetallic ducts.\*
  - Tape width: 2" minimum.
- Rigid Metal Ducts and components
  - Tapes shall be UL 181 listed and marked "181A-P" or 181B-FX".
    - Exception: "Butyl tape" (metallic tape with butyl adhesive) may be used to seal rigid metal-to-metal connections.**
    - Butyl adhesive shall be at least 15 mils thick.
    - Tape shall meet surface burning requirements per Item 1.
  - Tape width: 2" minimum.
- Rigid Fiberglass Ducts
  - Tape shall be UL 181A listed and marked "181A-P".
  - Tape width: 2-1/2" minimum.
- Access Panels
  - Pressure sensitive metallic tape with non-butyl adhesive.
- High Temperature Applications
  - Pressure sensitive metallic tape with non-butyl adhesive and service temperature rating of at least 265°F.

**\*No tape with butyl adhesive has been successfully tested under current UL 181B protocol. However, test procedures are being investigated, and UL listed and marked metallic tapes with butyl adhesive may be available in the future.**

#### 6. AEROSOL-APPLIED SEALANT SYSTEMS

- All Ducts
  - An approved\* aerosol-applied sealant system shall be used which meets the requirements of CEC Title 24, Residential Manual, Chapter 2, Section 150(m).
  - Aerosol-applied sealants utilized shall:
    - be non-toxic.

- be fire rated in conformance with UL 723 (see Item 1).
- meet all performance standards established by the manufacturer of the aerosol sealing equipment.
- have passed 50,000-heating-cycle accelerated testing for seal longevity (air temperature swings between 70°F and 200°F, and pressure differential swings between 0 Pa and 150 Pa).

## **7. DRAWBANDS**

- All Ducts
  - Drawbands shall:
    - comply with duct manufacturer's installation instructions.
    - conform to the following specifications:
      - Weather- and UV-resistant duct ties or stainless steel worm drive clamps.
      - Loop tensile strength: 150 pounds minimum.
      - Service temperature rating: 165°F minimum.

**\*Example: Aerosol system bearing U.S. Patent No. 5,522,930, Method and Device for Producing and Delivering an Aerosol for Remote Sealing and Coating.**

## **8. ALL FLEXIBLE DUCTS**

- Ducts shall conform to NFPA 90B and UL 181 Class 1.
- Nonmetallic insulated ducts with air-permeable core not allowed.
- Insulation shall have minimum thermal resistance of R-4.2.
- Vapor barrier:
  - Thickness: 2.5 mils minimum.
  - Permeance: 1.0 perm maximum.
  - UV degradation resistance recommended.

## **9. FLEXIBLE METALLIC DUCTS**

- Ducts shall be rated to withstand the designated pressures and velocity of the system, but not less than:
  - 2 inches of water column (IWC) (500 Pa) positive pressure,
  - 0.75 IWC (188 Pa) negative pressure, and
  - 2500 fpm velocity.
- Core shall be fabricated from minimum 0.0065" thick aluminum material or equivalent.

## **10. FLEXIBLE NONMETALLIC DUCTS**

- Ducts shall be rated to withstand the designated pressures and velocity of the system, but not less than:
  - 2 IWC (500 Pa) positive pressure,
  - 0.75 IWC (188 Pa) negative pressure, and
  - 2000 fpm velocity.
- Duct Core ("Inner Liner")

- Core shall be fabricated with a spring steel helix bonded within a nonporous material (e.g., molded composite or 2-ply lamination of polyester).
- Air-permeable core not allowed.

### 11. RIGID FIBERGLASS DUCTS

- Shall conform to NFPA 90B and UL 181 Class 1.
- Shall be constructed of high-density fiberglass duct board.

### 12. RIGID METAL DUCTS

- Shall conform to NFPA 90B and UL 181 Class 1 or Class 0.
- Shall be constructed of noncorrosive material.
- Rectangular metal ducts shall conform to UMC requirements.
- Round metal ducts shall conform to minimum thickness requirements of the UMC, some of which are shown in the table below.

ROUND METAL DUCTS At Positive Static Pressure up to 2 IWG (500 Pa)		
DIAMETER of Duct	MIN. SHEET GAGE (Galvanized Steel)	MIN. B. & S. GAGE (Aluminum)
Up to 14"	26	24
15" to 23"	24	22
24" to 37"	22	20
38" to 51"	20	18

### 13. SHEET METAL

- All Rigid Components
  - Components shall be constructed of noncorrosive materials.
  - Fittings (starting collars, splicing sleeves/couplings, adjustable elbows, wyes, etc.) shall have wall thickness (gage) no thinner than specified for attached ducts (see Item 12 above).
- Minimum Requirements for Fittings Used with Flexible Nonmetallic Ducts
  - Starting Collars
    - 4" installed length (6" recommended).
    - 26 gage galvanized steel up to 14" diameter.
  - Splicing Sleeves
    - 6" length (8" recommended).
    - 26 gage galvanized steel up to 14" diameter.
  - All Fittings
    - Fittings shall be beaded at each core connection (e.g., both ends of a sleeve) when flexible nonmetallic ducts are attached.
    - Exception: When a preexisting fitting is not beaded, the core's wire coil shall be secured to the fitting as prescribed in Item 30.**

## 14. DUCT SUPPORTS

- All Ducts
  - Support materials shall be corrosion resistant and shall:
    - conform to duct manufacturer's installation instructions.
    - be installed in compliance with Item 21.
- Flexible Ducts (Horizontal and Vertical)
  - Nonmetallic Support Straps
    - Not allowed pending availability of UL listing/classification for use with listed duct/closure systems.
  - Sheet Metal Support Straps and Saddles
    - Width: 1-1/2" minimum.
    - Thickness: 26 gage minimum.
  - Support Saddles
    - Shall fit neatly around and cover lower half (180°) of duct.
    - Shall not constrict inner diameter of duct nor cut the jacket.
- Horizontal Rigid Round Metal Ducts
  - Up to 10" Diameter
    - Galvanized steel straps, same gage as duct, 1" minimum width, or
    - 18 gage galvanized steel wire.
  - 11" to 40" Diameter
    - Galvanized steel straps, same gage as duct, 1" minimum width, or
    - 8 gage galvanized steel wire tied to a galvanized steel band, 1" minimum width, surrounding the duct.
- Vertical Rigid Round Metal Ducts
  - Up to 10" Diameter
    - 18 gage galvanized steel straps, 2" minimum width.
  - 11" to 20" Diameter
    - 16 gage galvanized steel straps, 2" minimum width.
- Horizontal Rigid Rectangular Metal Ducts
  - Maximum Side of Duct 30"
    - 1" x 18 gage strap
  - Maximum Side of Duct Over 30"
    - 1" x 1/8" strap
- Vertical Rigid Rectangular Metal Ducts
  - Maximum Side of Duct 24"
    - 1" x 1/8" strap
  - Maximum Side of Duct 36"
    - 1" x 1" x 1/8" angle bracket
- Rigid Fiberglass Ducts
  - Supports shall be in conformance with local codes.



## 15. CAULKING MATERIALS

- All Materials
  - Shall be non-toxic.
- Latex Sealing Compounds
  - Shall be in conformance with ASTM C834-95.
- Butyl Rubber Sealants
  - Shall be in conformance with F.S. TT-S-001657 (10/70)
- Elastomeric Joint Sealants (Including Polysulfide, Polyurethane, and ~~Stone~~)
  - Shall be in conformance with ASTM C920-94.

## 16. CORK TAPE

- Shall be non-toxic.
- Shall be non-corrosive to copper.
- Elongation: 200% minimum.
- Hardening: 37% maximum.

## INSTALLATION AND PERFORMANCE CRITERIA

### 17. DUCT SYSTEM DESIGN AND PERFORMANCE

- New Duct System Design
  - Supply and return plenums, ducts and registers shall be designed/selected in accordance with standard practices set forth by ACCA.
  - Air flow and static pressure shall be as specified by HVAC manufacturer.
- Duct System Airflow
  - After duct system repair, installation and sealing is complete, airflow through the system shall not be less than required by manufacturer.
  - If too low, corrective steps shall be taken.
- Combustion Appliance Safety (CAS) Testing prescribed in the Program Policy & Procedures shall be conducted in accordance with Chapter 4:
  - Before performing Duct Installation and Sealing.
  - After completing Duct Installation and Sealing.
- Duct System Balance
  - Duct systems shall be balanced to provide adequate air movement throughout the living space with interior doors closed.
  - Rooms closed off by doors from the FAU return intake shall be provided with an adequate return air path.
  - The required return air path for each room shall be provided by a permanent means, such as one of the following:
    - A transfer or jump duct from the room to the hallway.
    - Uncloseable grilled or louvered venting in the door or wall.
    - An undercut door leading to the hallway.

## 18. GENERAL INSTALLATION CRITERIA

- All Duct Installations
  - Installation shall comply with these standards, manufacturer's instructions and local codes, with the more stringent requirements taking precedence.
  - Ducts shall be:
    - installed with at least 4" of separation from earth.
    - protected from physical damage.
    - installed in locations not exposed to the weather, unless designed for exterior use.
    - supported as prescribed in Item 21.
  - Ducts installed within a closet or room shall be enclosed within a cavity constructed of materials equivalent to those used in construction of the closet/room.
  - A building cavity shall not be used as a duct without a sealed duct board or metal liner.
  - Existing platform returns shall be sealed per Item 34.
  - Existing crawl space plenums shall be abandoned per Item 35.
- Vertical Duct Installations
  - Rigid metal duct strongly recommended.
  - Flexible Ducts
    - Maximum vertical duct length shall be per manufacturer's instructions or 15', whichever is less.
    - Supports shall be installed at intervals not exceeding 6'.
    - Flexible ducts shall not be used for vertical risers in duct systems serving more than two stories. Such ducts shall not penetrate construction where fire dampers are required.
- Ducts Concealed in a Chase
  - Draft stops shall be installed (per UBC Section 708):
    - at every floor level, and
    - between the top story and the roof or attic space.
  - Draft stops shall be noncombustible (e.g., 24 gauge sheet metal collar).
- Surface Preparation
  - Preparation shall be in conformance with duct and sealant manufacturers' instructions.
  - Surfaces shall be:
    - cleaned prior to application of tapes and sealants.
    - free of dust, dirt, oil, grease, moisture and similar substances.
- Air Handler Operation
  - Air handler shall:
    - be off during the application of all tapes and sealants.
    - remain off for the drying time specified by sealant manufacturer.

## 19. DRAWBAND INSTALLATION

- All Ducts
  - Drawbands shall be:
    - weather- and UV-resistant duct ties or stainless steel worm drive clamps (see Item 7).
    - installed per manufacturer's instructions and tightened appropriately with an adjustable tensioning tool.

## 20. FLEXIBLE DUCT PRECAUTIONS

- Temperature Limit
  - Air flowing through flexible ducts shall not exceed 250°F.
  - Minimum distance from FAU to nonmetallic flexible duct shall be as specified by manufacturer or local code, whichever is greater.
- Harmful Exposure
  - Flexible ducts shall be installed to avoid exposure to:
    - sunlight (e.g., near turbine vents, windows, etc.).
    - sources of heat which exceed duct temperature limit.
    - other conditions that cause damage and/or degradation.
- Configuration
  - Ducts shall be installed:
    - fully extended, not compressed.
    - using minimum length required to make connections (e.g., run from trunk to register boot no longer than necessary).
    - in a manner which prevents:
      - dislocation, damage, or constriction of inside diameter.
      - incidental contact with metal fixtures, pipes or conduits.
- Duct Bends
  - Bends shall not be made across sharp corners or in any manner which restricts airflow.
    - Angle of bend shall not exceed 90 degrees.
    - Radius of the bend (measured from the center point of arc to centerline of duct) shall equal at least one duct diameter.

## 21. DUCT SUPPORT INSTALLATION

- All Ducts
  - Supports shall comply with duct manufacturer's instructions and local codes.
- Flexible Ducts
  - All Installations
    - Straps and other means of support shall not constrict the duct below its rated internal diameter.
    - Duct may rest on ceiling joists or truss members if:
      - support spacing and sag limitations are met.

- duct is not wedged between truss members.
  - Termination devices (e.g., register boots) shall be properly secured and shall not rely upon duct for support.
- Flexible Ducts (continued)
  - Horizontal Flexible Ducts
    - Spacing between supports shall be 4' maximum.
    - Sag shall be no more than:
      - 1/2" per foot of distance between supports.
      - 2" between supports.
  - Vertical Flexible Ducts
    - Spacing between supports shall be 6' maximum.
- Rigid Round Metal Ducts
  - Horizontal Installations
    - Spacing between supports shall be 10' maximum.
    - Support shall tightly encircle the duct.
  - Vertical Installations
    - Spacing between supports shall be 12' maximum.
- Rigid Rectangular Metal Ducts
  - Horizontal Installations
    - Spacing between supports shall be 10' maximum.
    - Support straps shall be secured to sides of duct with sheet metal screws, rivets or bolts.
  - Vertical Installations
    - Spacing between supports shall be 12' maximum.
- Rigid Fiberglass Ducts
  - Ducts shall be supported and reinforced in conformance with local codes.
- Horizontal Plenums (Metal and Fiberglass Duct Board)
  - Shall not rely on furnace for support.
  - Shall be independently supported at each end, and intermediately if over 10' in length.

## 22. REGISTER GRILLES

- All Units
  - The entire perimeter of the register shall be in contact with the mounting surface (ceiling, floor, wall).
  - Sealant applied to perimeter of the register boot shall not interfere with removal and replacement of the register.
  - Damaged and defective registers should be replaced.

## 23. EXPOSED DUCTS

- Rigid metal ducts shall be used:
  - in areas subject to human contact.
  - under floors without foundation walls.
  - in exterior locations.

## SEALING REQUIREMENTS

### **24. CLOSURE SYSTEMS**

- All Closure Systems
  - A complete, durable seal shall be achieved.
  - Joints and seams shall be mechanically secured in conformance with these standards and the UMC.
- Externally-Applied Closure Systems
  - Sealing materials shall be centered over the joint or gap and shall extend at least 1" onto each of the two joined/sealed surfaces.
  - Sealing materials may be:
    - Duct mastic alone (gaps up to 1/8"), or a mastic-plus-mesh combination (gaps over 1/8").
    - Pressure sensitive tape alone (gaps up to 1/4"), or a tape-plus-mastic combination (gaps over 1/4").
- Internally-Placed Mastic Sealant (Core-to-Fitting Joints)
  - Mastic may be applied either:
    - inside the duct core, or
    - onto the rigid component over which the core is attached.
  - Mastic coating shall be at least 1/8" thick and 2" wide.
- Aerosol-Applied Sealants
  - Sealants shall be injected into the duct system using an approved aerosol system.
- Factory Fabricated Sections
  - All factory installed closure systems shall be fabricated to meet the requirements of UL 181 standards under the Factory Follow-Up Service Program.
  - Compliance shall be verifiable by:
    - visible markings on the joint, or
    - manufacturer's written certification.
- Field Fabricated Sections
  - Tapes shall be marked, and mastic containers shall be labeled, in conformance with:
    - UL 181A for rigid fiberglass ducts.
    - UL 181B for flexible metallic and nonmetallic ducts.
    - UL 181A or 181B for rigid metal ducts and components.
      - *Exception:* "Butyl tape" without UL 181 markings is allowed per Item 5.

### **25. SEALING WITH DUCT MASTIC**

- All Connections
  - Mastic shall be installed as prescribed by manufacturer:

- with proper surface preparation/cleaning.
- within temperature and moisture limitations.
- with proper setup time.
- Rigid Metal Ducts and Components
  - Mastic by itself may be used to seal gaps up to 1/8" (e.g., on adjustable elbow joints, seams in wyes, metal duct seams, etc.).
  - Mastic shall be reinforced with fiberglass mesh tape when used to seal gaps larger than 1/8".
  - When sealing longitudinal seams in new rigid metal ducts, mastic is required on S-and-drive, snap lock, and government lock seams.
- Flexible Metallic and Nonmetallic Ducts
  - Mastic used to seal core-to-fitting connections may be:
    - externally applied over the duct core and rigid fitting, or
    - internally placed between the core and the fitting.
  - Externally-Applied Mastic
    - Mastic shall be reinforced with fiberglass mesh tape when:
      - a gap greater than 1/8" exists between the duct core and the fitting (starting collar, coupling, elbow, wye, etc.).
      - mastic is used to seal the outer vapor barrier (jacket).
- Reinforcement of Mastic with Fiberglass Mesh Tape
  - Mesh fabric shall be imbedded between two layers of duct mastic to form a mastic closure system.
    - The first layer of mastic shall:
      - be centered over the joint or gap to be sealed.
      - extend at least 1" onto each of the joined surfaces.
      - extend beyond the width of the mesh.
    - The mesh fabric shall be:
      - embedded in the mastic.
      - applied at least one layer thick over the entire joint or gap.
      - wrapped around the entire circumference on transverse joints (e.g., where two sections of duct are joined together).
    - A second layer of mastic shall be installed over the mesh, filling the scrim pattern completely and covering the mesh.
  - Width of mesh tape shall be as prescribed in Item 3.

## 26. SEALING WITH TAPE

- Pressure Sensitive Tapes
  - Tapes shall be installed as prescribed by manufacturer:
    - with proper surface preparation/cleaning.
    - with recommended amount of pressure applied.
    - within temperature and moisture limitations.
  - Successive wraps of tape shall be staggered and should overlap by 50 to 75% of the tape width.

- At least three wraps of tape shall be applied when sealing:
  - Transverse joints in round or rectangular metal ducts (the joint formed when two pieces of duct are spliced together).
  - Flexible duct core-to-fitting attachments (with a drawband also installed to secure the core).
  - Vapor barrier (jacket) splices on flexible ducts.
- Gaps wider than 1/4" sealed with tape:
  - Duct mastic shall be applied at least 1/8" thick over the installed tape to provide additional strength and durability.
  - Mastic shall extend beyond the width of the tape.
- Heat Activated Tape
  - Tapes shall be installed as prescribed by manufacturer.
  - Heat and pressure shall be applied until heat indicator dots have darkened on all tape surfaces.
- Tapes for High Temperature Applications
  - Pressure sensitive tape with a service temperature rating of at least 265°F shall be used when sealing:
    - within 1" of a double-wall gas flue/vent pipe.
    - within 6" of a single-wall gas flue/vent pipe.

## **27. SEALING REFRIGERANT LINES**

- Cork tape shall be used for sealing gaps where refrigerant lines penetrate the plenum or cabinet of the FAU.

## **28. SEALING REMOVABLE SERVICE PANELS**

- When service panels, filter access covers, etc. are sealed, UL 181A or 181B pressure sensitive tape with thin adhesive shall be used.

## **29. SEALING WITH AEROSOL-APPLIED SEALANTS**

- All Ductwork and Components
  - Sealants shall be applied using an approved aerosol injection system (see Item 6).
  - Maximum Leak Size
    - Per aerosol system manufacturer's specifications, but no larger than 1/4".
  - Duct Types
    - Aerosol sealants may be used in the types of ducts and under the conditions specified by the aerosol system manufacturer.
- Application
  - Aerosol-applied sealing shall be performed in strict conformance with manufacturer's procedures, including:
    - Injection process and procedures that minimize wall deposition (e.g., automated injection control).

- Safety procedures to protect equipment, house, installers and one pants from unnecessary exposure to the sealant.
- Installer training requirements.
- Paper and electronic documentation of sealing process.

### 30. REPAIRING AND SEALING FLEXIBLE NONMETALLIC DUCTS

- Attachment of Duct Core to Fitting
  - At least 2" of duct core shall be pulled past the bead (on the starting collar, sleeve/coupling, elbow, wye, etc.).
  - Fitting must provide additional 1" wide area beyond duct core for application of tape or externally-applied mastic.
  - A drawband (duct tie or metal clamp) shall be:
    - placed behind the bead to secure the core onto the fitting.
    - installed per Item 19.
  - When a preexisting fitting is not beaded:
    - Duct core shall be secured to the fitting with internally-placed mastic (Item 24) and a drawband (Item 19) or
    - The core's wire coil shall be secured to the fitting with evenly-spaced #8 sheet metal screws plus mastic or tape.
      - Each screw shall penetrate a 2" x 2" or larger strip of metallic "181B-FX" tape externally applied to the duct core.
      - 3 screws for fittings under 12", 5 screws for 12" or larger.
- Sealing Methods
  - All Closure Systems
    - Materials and application shall be in compliance with Item 24.
  - Mastic and Fiberglass Mesh Tape
    - Mastic and mesh shall be installed as prescribed in Item 25.
  - Pressure Sensitive Tapes
    - Tape shall be installed in compliance with Item 26.
  - Aerosol-Applied Sealants
    - Aerosol sealants shall be applied in compliance with Item 29.
- Insulation and Vapor Barrier
  - Insulation shall completely cover the duct core and fitting.
  - The vapor barrier (jacket) shall be pulled back over the insulation.
    - Where two pieces of duct are joined (splices), the two jackets shall overlap at least 2".
    - Vapor barrier shall be secured/sealed with a drawband and/or three wraps of pressure sensitive tape.
- Core Repairs
  - Holes/damage in the duct core shall be repaired by removal of the ~~the~~ aged section and insertion of a sleeve/coupling.
- Jacket Repairs



- Rips and holes in the vapor barrier shall be repaired with pressure sensitive tape or with mastic and mesh tape.

### **31. REPAIRING AND SEALING FLEXIBLE METALLIC DUCTS**

- Attachment of Duct Core to Fitting
  - End of core shall be trimmed squarely.
  - Sleeve/coupling required at splices (field-installed when not integral part of the duct).
  - At least 1" of duct core shall be placed over fitting.
  - Fitting must provide additional 1" wide area beyond duct core for application of tape or mastic (when mastic is externally-applied).
  - Metallic core shall be secured to the fitting with:
    - a stainless steel worm drive clamp, or
    - #8 or larger sheet metal screws equally spaced and positioned at least 1/2" from end of core (3 screws for duct diameters under 12", and 5 screws for diameters 12" and larger).
- Sealing Methods
  - All Closure Systems
    - Materials and application shall be in compliance with Item 24.
  - Mastic and Fiberglass Mesh Tape
    - Mastic and mesh shall be installed as prescribed in Item 25.
  - Pressure Sensitive Tapes
    - Tape shall be installed in compliance with Item 26.
  - Aerosol-Applied Sealants
    - Aerosol sealants shall be applied in compliance with Item 29.
- Insulation and Vapor Barrier
  - Insulation shall completely cover the duct core and fitting.
  - The vapor barrier (jacket) shall be pulled back over the insulation.
    - Where two pieces of duct are joined (splices), the two jackets shall overlap at least 2".
    - Vapor barrier shall be secured/sealed with a drawband and/or three wraps of pressure sensitive tape.
- Core Repairs
  - Holes/damage in the duct core shall be repaired by removal of the damaged section and insertion of a sleeve/coupling.
- Jacket Repairs
  - Rips and holes in the vapor barrier shall be repaired with pressure sensitive tape or mastic and mesh tape.

### **32. REPAIRING AND SEALING RIGID METAL DUCTS**

- Joint Overlap (Contact Lap)
  - When two rigid components are joined (e.g., duct and starting collar, or two pieces of duct), they shall overlap at least 1-1/2".
- Mechanical Fasteners

- Connections shall be secured with #8 or larger sheet metal screws equally spaced, or an equivalent fastening method.
- Round Ducts
  - At least 3 screws for duct diameters up to 12", and 5 screws for larger diameters.
- Rectangular Ducts
  - At least 1 screw per side.
- Lapped Seams (e.g., field fabricated metal plenums, etc.)
  - Overlapped surfaces shall:
    - be in substantial contact with each other along the entire seam.
    - be securely fastened together (e.g., with #8 or larger sheet metal screws at intervals of 12" or less).
- Gaps 1/8" or smaller may be sealed with:
  - duct mastic alone, or
  - pressure sensitive tape, or
  - aerosol-applied sealant.
- Gaps larger than 1/8" shall be sealed with:
  - duct mastic embedded with fiberglass mesh, or
  - pressure sensitive tape (shall be applied in combination with mastic for gaps greater than 1/4"), or
  - aerosol-applied sealant (gaps up to 1/4" wide maximum).
- Sealing Methods
  - All Closure Systems
    - Materials and application shall be in compliance with Item 24.
  - Mastic and Fiberglass Mesh Tape
    - Mastic and mesh shall be installed as prescribed in Item 25.
  - Pressure Sensitive Tapes
    - Tape shall be installed in compliance with Item 26.
  - Aerosol-Applied Sealants
    - Aerosol sealants shall be applied in compliance with Item 29.

### **33. REPAIRING AND SEALING RIGID FIBERGLASS DUCTS**

- All Joints
  - Closure (Repair and Sealing) Materials
    - Mastic
      - UL listed and labeled "181A-M", reinforced with 3" wide fiberglass mesh tape.
    - Pressure sensitive tape
      - UL listed and marked "181A-P".
  - Externally-Applied Closure Systems
    - Required on all joints and seams.
    - Materials shall be centered over the joint/seam and provide a minimum 1" overlap onto joined surfaces.

- Aerosol-Applied Sealants
  - May be used to seal gaps up to 1/4" wide (e.g., small holes in the duct board or leaks in existing joint/seam closure system).
  - May not be used in place of externally-applied tape or mastic-plus-mesh as a joint/seam closure system.
- Shiplap Joints
  - Before sealing material is applied, joint shall be closed with outward-clinching staples installed through the stapling flap of the jacketing material.
  - Staples shall be minimum 1/2" long, and spaced 2" OC maximum.
- Butt Joints
  - When stapling flap is not present:
    - Cross tabs of closure tape:
      - shall be equally spaced on each side of the joint, minimum one cross tab per side.
      - shall be minimum 8" long and spaced maximum 12" OC.
      - may be placed either under or over closure tape.
- Starting Collars
  - Starting collar shall be securely installed and sealed with mastic.
  - Duct shall be mechanically attached (e.g., with sheet metal angle brackets, #10 screws and 2-1/2" square steel washers), and sealed.
- Pressure Sensitive Tape
  - Closure tape shall be rubbed firmly with a plastic squeegee until the facing reinforcement shows through (without causing staples to puncture the tape).
  - In temperatures below 50°F, tape and duct board shall be conditioned per UMC standards.
- Heat Activated Tape
  - Heat and pressure shall be applied per manufacturer's instructions until heat indicator dots have darkened on all tape surfaces.
- Mastic Reinforced with Fiberglass Mesh Tape
  - Mesh fabric shall be imbedded between two layers of duct mastic.
    - A thin layer of mastic at least 3-1/2" wide shall be centered over the joint seam.
    - Mesh fabric shall be:
      - pressed into the mastic.
      - applied at least one layer thick, overlapping itself when encircling a transverse joint.
    - A second layer of mastic shall be installed over the mesh, filling the scrim pattern completely.

### 34. SEALING BUILDING CAVITIES

- Leaks shall be sealed in existing building cavities being used as ducts (platform returns, joist cavity returns, kick registers, etc.).
- Repair materials/liner may include sheet metal, fiberglass duct board, and gasketing.
- Sealants may include:
  - Duct mastic alone (gaps up to 1/8").
  - Duct mastic plus fiberglass mesh tape (gaps larger than 1/8").
  - Approved caulk (e.g., elastomeric sealants).
  - Pressure sensitive tape (metal and foil surfaces).
  - Aerosol-applied sealants (gaps up to 1/4" wide).
- Foam board and foam sealants shall not be used.
- Platform shall be insulated (e.g., stud cavities filled with flexible insulation) when liner is not fiberglass duct board.

### 35. CRAWL SPACE PLENUMS

- New Duct Systems
  - The crawl space shall not be used as a plenum.
- Existing Crawlspace Plenum
  - The existing crawl space plenum shall be abandoned and replaced with a sealed air duct system.
  - Foundation vents shall be provided in conformance with local code when required.
  - Abandoned register holes shall be permanently closed off and sealed.

### 36. SEALING REGISTER BOOTS

- Boot-to-Duct Connection
  - All Closure Systems
    - Materials and application shall be in compliance with Item 24.
  - Mastic and Fiberglass Mesh Tape
    - Mastic and mesh shall be installed as prescribed in Item 25.
  - Pressure Sensitive Tapes
    - Tape shall be installed in compliance with Item 26.
  - Aerosol-Applied Sealants
    - Aerosol sealants shall be applied in compliance with Item 29.
- Leaks in the Boot
  - Leaks shall be sealed with one of the following:
    - Duct mastic alone (gaps up to 1/8").
    - Mastic plus mesh tape (gaps greater than 1/8").
    - Pressure sensitive tape (in combination with duct mastic on gaps over 1/4").
    - Elastomeric caulk (gaps up to 3/8").
    - Aerosol-applied sealants (gaps up to 1/4").

- Boot sealing material shall not interfere with removal or reinstallation of register.
- Boot-to-Floor/Wall/Ceiling Connection
  - Boot shall be mechanically secured to the structure and shall not rely on the duct for support or stability.
  - Gaps between boot and surrounding material shall be sealed with one of the following:
    - Elastomeric caulk (gaps up to 3/8").
    - Elastomeric caulk supported by backer rod (gaps 7/16" to 5/8").
    - Duct mastic (gaps up to 1/8").
    - Duct mastic reinforced with fiberglass (gaps over 1/8").
  - Exposed sealant that will interfere with register reinstallation or removal may be covered with pressure sensitive tape.
  - Pressure sensitive tape may be used to seal gaps up to 1/4" where caulk/mastic would interfere with reinstallation and removal of the register.

## INSULATION

### **37. DUCT INSULATION**

- Material
  - Flexible or rigid fiberglass.
  - Selected and installed per ASTM C971.
  - R-4.2 minimum, or as prescribed by local code and the Program Policy & Procedures.
- Coverage
  - All air ducts, air connectors, plenums, distribution boxes and system components shall be insulated.
    - Insulation is to be installed on portions of the duct system located outside of conditioned space.
    - Rigid metal ducts located entirely within conditioned space may be insulated to prevent condensation.
  - 100% coverage required without gaps or openings.
- Compression
  - Maximum 20% overall compression by attachments.
  - Maximum 50% compression in corners/bends.
- Clearances
  - Combustion air vents shall not be obstructed by duct insulation.
  - Combustible Facings and Attachments
    - 6" clearance from single wall gas flue/vent pipes.
    - 1" clearance from Type B double-wall gas flue/vent pipes.
    - 3" clearance from all other heat producing devices.
- Attachment of Rigid Fiberglass Insulation
  - Insulation shall be securely attached (e.g., with stickpins).

- Seams shall be sealed with:
  - pressure sensitive tape marked “181A-P”, or
  - heat activated tape marked “181A-H”, or
  - duct mastic labeled “181A-M” reinforced with mesh tape.
- Installation of Flexible Insulation
  - Insulation shall be permanently secured with one of the following:
    - Drawbands (duct ties).
    - Noncorrosive wire, 20 gage minimum.
    - Rust-resistant nails or staples.
    - Pressure sensitive tape (e.g., metallic or FSK) wrapped a minimum of 3 times around the circumference.
  - Spirally Wrapped
    - Wraps of unfaced insulation shall overlap each other at least 2".
    - Insulation shall be mechanically secured as needed to prevent gaps or openings.
  - Parallel Wrapped
    - Faced wraps shall be secured and sealed with pressure sensitive tape or as prescribed by manufacturer.
    - Unfaced wraps shall be mechanically secured with fasteners (drawbands, wire, nails, or staples) installed no more than 18" apart along the lengthwise seam (overlap) of the insulation.
- Vapor Barrier (Jacket)
  - Shall be installed when required by local code.
  - When installed, vapor barrier shall be placed on outermost side of the insulation.
- Flexible Ducts
  - Jacket Splices
    - When two jacket ends are joined together, they shall overlap at least 2".
    - Overlap shall be secured/sealed with a drawband and/or 3 wraps of pressure sensitive tape.
  - Duct Termination
    - Jacket shall be pulled over insulation and secured/sealed to fitting with one or more of the following:
      - A drawband.
      - 3 wraps of pressure sensitive tape.
      - Mastic and mesh tape.
- Exposed Ducts
  - Ducts Located Outdoors or Not Protected from the Elements
    - Ducts shall be insulated with materials which are:
      - intended for exterior applications.
      - selected and installed in conformance with manufacturer’s instructions and local codes.

- Ducts Located in Area Subject to Human Contact
  - When fiberglass insulation is installed, it shall be faced.
  - Fiberglass edges shallnot be left exposed.

## SECTION 6

### WATER HEATER INSULATION STANDARDS

#### 1. APPROVED MATERIALS

- All Materials
  - Maximum flame-spread index of 25 and maximum smoke-developed index of 50, per ASTM E84-91a, or UL 723, or NFPA 255.
- Water Heater Blanket
  - Mineral fiber only, with vinyl or fiber-reinforced foil facing.
- Tape
  - Vinyl or fiber-reinforced foil compatible with facing.
  - Minimum width 3".
  - Duct tape not allowed.
- Straps and Buckles
  - Polypropylene blanket straps and compatible buckles or other mechanical strap locks; tying of straps is not allowed.

#### 2. R-VALUE

- R-6 minimum.

#### 3. COVERAGE

- Gas Water Heaters
  - Top of Tank
    - Shall not be insulated.
  - Sides of Tank
    - Side insulation shall:
      - Completely surround tank.
      - Extend from top of tank to bottom of drain valve neck.
    - Side insulation shall not extend beyond bottom of tank or in any way restrict combustion air access.
- Electric Water Heaters
  - Top of tank
    - Shall be completely covered with insulation.
  - Sides of Tank
    - Side insulation shall
      - Completely surround tank.
      - Extend down to bottom of drain valve neck.

#### 4. TOP SEAMS AND EDGES

- Gas Water Heaters
  - Top edge of blanket shall be sealed to top of tank with tape around the entire perimeter of tank.
- Electric Water Heaters
  - Top Seams
    - Perimeter of top cover shall be sealed to top edge of blanket with tape.



- All seams and slits in cover shall be sealed with tape.

## 5. SIDE SEAMS AND BOTTOM EDGE

- Side Seams on All Water Heaters
  - Cross Straps
    - All splices shall be reinforced with minimum 10" long cross straps of tape.
    - Cross tapes shall be located a maximum of 18" apart.
  - Splices With Minimum 2" Wide Flap of Facing Material
    - Pieces shall be joined securely and sealed with tape the full length of the flap.
  - Splices Without Flap
    - Blanket shall be overlapped at least 2".
    - Seams shall be sealed with tape the full length of the splice.
- Bottom Edge on Water Heaters Within the Living Space Not In an Enclosure)
  - Bottom edge fiberglass shall not be left exposed.
    - The bottom edge shall be sealed to the tank with tape er
    - The facing shall be tucked under and taped permanently in place.

## 6. BLANKET STRAPS AND BUCKLES

- All Water Heaters
  - A minimum of three (3) blanket straps shall be installed in addition to tape.
  - Straps shall be secured with buckles or other mechanical strap locks; tying of straps is not allowed.
  - Straps shall be installed:
    - One strap within 1-3" of the top of the blanket
    - One strap within 1-3" of the bottom
    - One strap midway on the blanket
  - Straps shall not be placed over thermostat cover plates, controls, valves or burner access door.
  - Straps shall provide a snug fit, with minimal compression of blanket under straps only.

## 7. TEMPERATURE AND PRESSURE (T&P) RELIEF VALVE

- All Water Heaters
  - T&P valve shall be present and located within 6" of the tank.
  - T&P valve outlet shall not be plugged or capped.
  - In conformance with local codes.
  - Valve shall not be covered by the blanket.
  - End of drain line shall not be covered or obstructed by the blanket.

## 8. DRAIN VALVE

- All Water Heaters
  - The drain valve shall not be covered by the blanket.
  - Minimum 1/2" clearance required between the blanket and the valve.

## **9. EARTHQUAKE STRAPS AND BRACES**

- Earthquake Straps and Bracing Devices Attached Directly to Tank (Not to the Water Pipes)
  - Straps and braces shall not be removed when insulation blanket is installed.
  - The blanket shall be slit to fit around straps and braces.
  - All slits shall be securely taped.

## GAS WATER HEATERS

### **10. THERMOSTAT CONTROL UNIT**

- Control unit shall not be covered by blanket or tape.
- Strap shall not be placed over front of control unit.

### **11. BURNER ACCESS AND DRAFT HOOD**

- Minimum 3" clearance required from blanket and tape to edge of:
  - Burner access opening.
  - Draft hood opening.

### **12. GAS APPLIANCE VALVE**

- Valve shall not be covered.

### **13. COMBUSTION AIR SUPPLY**

- Air path shall not be obstructed.
- When unit is located in attic with loose fill insulation present, blocking shall be installed per Section 7.

### **14. OPERATION AND SAFETY INSTRUCTIONS**

- Identification label, safety information and lighting instructions shall be identified and made easily accessible.
  - A flap (top-hinged when possible) shall be cut in blanket to provide access.
  - Flaps shall be held closed with tape.
    - A minimum of one tape strip shall be installed along slit opposite flap hinge.
    - All slits longer than 12" shall be secured with tape installed lengthwise along the slit.
  - Flaps shall be labeled in permanent ink to identify what is underneath (e.g., "Safety Instructions").

## ELECTRIC WATER HEATERS

### **15. THERMOSTATS AND IDENTIFICATION LABEL**

- Upper and Lower Thermostats
  - Locations shall be identified and made easily accessible.
    - Blanket shall be cut on sides and bottom to create a top-hinged flap over each thermostat cover plate.
    - Flap shall be held closed with tape installed along bottom slit.
    - Each flap shall be labeled in permanent ink: "Thermostat".
- Identification Label

- The location shall be:
  - Marked but not cut.
  - Labeled in permanent ink to identify them : (i.e., Lighting Instructions, Model Number, etc.)

## 16. UNIT LOCATION

- All Water Heaters
  - Unit must be located in protected area which is not exposed to the weather.
  - Units in both conditioned and unconditioned space shall be insulated.
  - Unit shall not be insulated if less than 12" from a gas cook stove.
- Gas Water Heaters
  - Clearance requirements prior to blanket installation:
    - Minimum 1" clearance on sides and back.
    - Minimum 6" clearance in front.
- Electric Water Heaters
  - Clearance requirements prior to blanket installation:
    - Minimum 1" clearance on sides and back.
    - Front clearance shall be sufficient to allow the enclosure door to close freely with blanket installed.

## 17. COMBUSTION SAFETY REQUIREMENT—GAS UNITS

- Combustion Air Supply
  - Both an upper and lower combustion air vent shall be present.
  - Vents shall not be obstructed.
- Evidence of Improper Combustion
  - Insulation shall not be installed when there is evidence of improper combustion, such as:
    - Soot accumulation near draft hood or on floor underneath tank.
    - Scorching or smoke residue at the draft hood or combustion chamber access.
- Combustion Chamber Access Cover
  - Insulation can be installed only if both burner access doors are present OR if at least one access door is present and there are no signs of scorching or incomplete combustion.

## SECTION 7

### WATER HEATER PIPE INSULATION STANDARDS

#### 1. APPROVED MATERIALS

- All Materials
  - Maximum flame-spread index of 25 and maximum smoke-developed index of 50, per ASTM E84, UL 723, or NFPA 255.
- Insulation
  - Materials
    - Preformed foam (e.g. closed cell polyethylene) conforming to ASTM C534.
  - Inside diameter of preformed material shall be appropriate for the size pipe being insulated.
  - Minimum thermal performance rating of 180°F.
- Tape
  - Preformed Foam Insulation
    - Tape specified by insulation manufacturer or
    - Minimum 2" wide pressure-sensitive metallic tape meeting or exceeding strength and adhesive requirements of UL 181A-P or UL 181B-FX.
  - Cloth duct tape and electrical tape are not allowed.

#### 2. R-VALUE

- All Materials
  - R-4 minimum for pipes less than or equal to 2" in diameter.
  - R-5 minimum for pipes greater than 2" in diameter.
- Preformed Pipe Insulation.
  - 1" or greater wall thickness.

#### 3. SHEET OR SEMI-MOLDED INSULATION

- All Units
  - Not allowed.

#### 4. HEAT TAPE OR STRAP INSULATION

- All Units
  - Not allowed.

#### 5. PIPES TO BE INSULATED

- All Water Heaters
  - Hot and cold water pipes shall be insulated which are:
    - Connected to the water heater, and
    - Under continuous water pressure.
  - Insulation shall be installed on both rigid and flexible lines as feasible.
  - Leaking pipes shall not be insulated.

## **6. COVERAGE REQUIREMENTS**

- Water Heater Pipes
  - Insulation shall cover all accessible portions of the first 5 feet of each pipe (hot and cold).
  - Insulation must begin within the first 3" from the heater.
  - Elbows and curves shall be covered without gaps.
  - Valves shall be covered, but handles shall be left clear to operate freely.

## **7. COVERAGE RESTRICTIONS**

- All Units
  - Materials shall not cover:
    - Temperature and pressure (T&P) relief valve.
    - Valve handles.
    - Control and safety devices.
    - T&P drain line.
    - Leaking pipes.
- Gas Units
  - Minimum 3" clearance required from combustible insulation materials to draft hood opening and gas vent pipe.
  - No part of the draft hood opening shall be obstructed.

### PREFORMED PIPE INSULATION

## **8. POSITION OF SLITS**

- Preformed Foam
  - Slits shall be positioned downward on horizontal pipe.

## **9. CORNERS, BENDS, AND JOINTS**

- Preformed Foam
  - Insulation shall be mitered and/or notched on bends, corners, and joints to provide complete closure.

## **10. GENERAL ATTACHMENT REQUIREMENTS**

- Preformed Foam
  - Insulation shall be firmly secured with plastic ties (e.g., UV-resistant cable ties), tape, wire, or sleeves.
  - All slits and joints shall be glued or taped to achieve complete closure.
  - All material shall be corrosion-resistant.
  - Plastic ties should be UV-resistant.
  - Tape shall be used on corners, 90° elbows, and joints.

## **11. GLUE FOR ATTACHMENT**

- Preformed Foam
  - Glue shall be compatible with insulation and manufacturer's instructions.

## **12. TIES AND TAPE FOR ATTACHMENT**

- Preformed Foam

- Attachments shall be plastic or corrosion-resistant metal.
- Attachments shall be installed:
  - A maximum of 12" apart,and
  - Within 1" of each end.
- 1/4" total compression at ends only.

### **13. SLEEVES FOR ATTACHMENT**

- Preformed Foam
  - Sleeves:
    - Shall be corrosion-resistant metal.
    - Shall not compress insulationexcept for 1/4" total compression at ends.

## **SECTION 8**

### **COVER PLATE GASKET STANDARDS**

#### **1. APPROVED MATERIALS**

- All gaskets shall be:
  - Fire-resistant.
  - Pre-cut to fit.
  - Closed cell foam.
  - 1/8" thick minimum.

#### **2. LOCATION**

- Gaskets shall be installed:
  - In conditioned space only.
  - On walls between conditioned and unconditioned space.
  - Under cover plates for:
    - Electrical switches and receptacles.
    - Telephone and TV cable service entrances.

#### **3. INSTALLATION**

- Gasket shall cover the gap between the utility box and the surrounding wall material.
- When utility box is odd size and standard gaskets will not work, caulking gap between box and wall is recommended.
- Plate shall:
  - Cover gasket completely.
  - Be replaced if cracked during reinstallation.

## SECTION 9

### ENERGY SAVER SHOWERHEAD AND FAUCET AERATOR STANDARDS

#### 1. APPROVED MATERIALS

- Showerheads and Aerators
  - Conformance to ANSI/ASME A112.18.1M-1996.
  - Showerhead must be listed in the California Energy Commission current Directory of Plumbing.
  - Showerhead must have a minimum 3-year material warranty.
- Showerheads
  - “Self-cleaning” type or cleanable without being unscrewed from the showerarm.
  - Non-aerating type.
  - Threaded base shall be metal.
- Showerarm Adapters
  - Adapter shall be metal (e.g., chrome-plated brass) or thermoplastic (e.g., Celcon or Delrin).
  - Minimum 5/8" long male pipe threads with a minimum taper of 3% on showerhead end.
- Aerators
  - Shall be metal (e.g., chrome-plated brass).

#### 2. WARRANTY

- Showerheads and Aerators
  - Minimum three-year warranty.

#### 3. FLOW RATE

- Showerheads
  - Maximum flow rate: 2.50 gpm at 80 psi.
  - Minimum flow rate: 2.0 gpm at 40 psi.
- Faucet Aerators
  - Maximum flow rate: 2.50 gpm at 80 psi

#### 4. SHOWERHEAD FLOW CONTROL

- Flow-restricting devices shall be factory-installed and mechanically retained (e.g., with a retaining ring or expansion seat).
- Removable flow restrictors are not allowed.

#### 5. INSTALLATION

- Functional Showers
  - Low flow showerheads shall be installed on all functional showers, including those not currently in use.
- Nonfunctional Showers



- Low flow showerheads shall not be installed on showers that are not functional due to plumbing or physical defects.
- Showerarms
  - Showerarms shall not be removed or replaced.
  - Showerheads shall not be installed on plastic showerarms.
- Showerarm Adapters
  - Adapters shall be installed when required for installation of low flow showerheads.
- Showerhead
  - Must not leak at connection to neck/arm.
- Faucet Aerators
  - Aerators shall be installed only on faucets that provide hot water.

## **6. POST-INSTALLATION REQUIREMENTS**

- Showerheads, showerarm adapters, and faucet aerators shall function properly.
- Threaded connections shall not leak.

**SECTION 10**  
**EVAPORATIVE COOLER AND AIR CONDITIONER**  
**VENT COVER STANDARDS**

**1. APPROVED MATERIALS**

- All Covers
  - Maximum perm rating shall be 1.0.
- Plastic Covers
  - Rigid plastic or minimum 12 mil film.
  - Film shall be framed with aluminum, rigid plastic or finished hardwood.
- Metal Covers
  - Aluminum, galvanized, or painted metal.
- Wood Covers
  - Finished wood only.
  - Bare wood shall be sealed/finished with paint, urethane, varnish, or stain.

**2. LOCATION**

- Placement
  - Cover shall be placed to block infiltration.
  - Interior installations only; exterior covers not allowed.
  - All wall and ceiling vents must be covered.
- Shared Ducts
  - Cover shall not be installed when the cooler and a heating unit use a common duct system.

**3. EASY REMOVAL**

- All Units
  - Cover shall be held securely in place yet be easy to install and remove.
- Flanged Covers
  - Cover shall be secured with rotating clips or magnetic strips.
- Covers Without Mounting Flange
  - Cover may be held in place with weatherstripping (e.g., foam weatherstripping tape installed on interior for a friction fit).

**4. MOUNTING FLANGE**

- Unobstructed Locations
  - Each edge of the cover shall be a minimum of 1/2" wide to accommodate attachment and weatherstripping.
- Obstructed Locations
  - Flange may be trimmed on one side to facilitate installation if cut side can be sealed against air leakage.

**5. WEATHERSTRIPPING**

- All Covers
  - Perimeter of cover shall be sealed against air leakage.

- Weatherstripping Materials
  - Open cell foam or hollow gasket weatherstripping.
  - Magnetic strip may be used in lieu of weatherstripping if an airtight seal is achieved (i.e., installed without gaps).

## 6. ATTACHMENT

- All Types
  - Attachment shall be secure and permanent.
- Screws
  - Screws shall penetrate:
    - Solid wood at least 1/2", or
    - Sheet metal (no sharp edges), or
    - An anchoring device (e.g., drive or expansion type anchor).
- Rotating Clips
  - Barrel of clip shall rest on mounting surface.
  - Clips shall be placed within 4" of each corner, minimum of two clips per side.
  - Clip and cover shall be made of compatible materials.
- Magnetic Tape
  - Tape shall be:
    - Permanently attached to mounting surface and cover.
    - Adequate to hold cover securely in place.
    - Continuous around the entire perimeter if weatherstripping ~~is~~ used.
- Anchors
  - Drive Anchors, Expansion Anchors, Molly Bolts, etc.
    - Mounting surface shall be appropriate and conform to manufacturer's installation specifications.
- Toggle Bolts
  - Shall have a minimum 3/8" diameter
  - Shall be flat head

## 7. FURRING STRIPS

- Obstructed Locations
  - Furring strips may be installed as spacers which allow the cover to clear the obstruction (such as an electric wire).
  - Furring strips shall:
    - Be made of finished wood.
    - Be securely attached to the structure.
    - Create a continuous, smooth mounting surface for the cover.
  - Gap/hole created by obstruction shall be sealed (e.g., with caulk).

## 8. POST-INSTALLATION REQUIREMENTS

- Paint dust and chips, scraps, and other debris resulting from vent cover installation shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.

- Furniture and other household items moved for weatherization work shall be returned to normal.

## SECTION 11

### CENTRAL HVAC AND WALL/WINDOW AIR CONDITIONER FILTER AND SIGNAL STANDARDS

#### 1. APPROVED MATERIALS

- Filters
  - Shall be washable.
  - Shall be UL listed Class2 filter material.
  - Shall conform to A.R.I. Standard 680 and UL-900 or UL-1096.
  - “Hog Hair” Type Bonded Fiber
    - 1" thickness shall be used in conventional HVAC systems and approved mobile home units.
    - 1/2" thickness shall be used in wall/window air conditioners and approved mobile home HVAC units.
  - Foam
    - 1/4" single layer foam, 20 to 30 pores per inch (ppi).
    - Foam shall be installed only when bonded fiber is not feasible or is prohibited by the appliance manufacturer.
  - Other Materials
    - “Sock” type foam and other specialty materials may be installed where required by appliance manufacturer.

#### 2. FILTER SIZE AND INSTALLATION

- Size
  - Unframed filters shall be cut for a snug fit with maximum 1/4" tolerance.
  - Framed filters shall fit within the filter housing without crimping or buckling.
- Installation
  - All filters shall be installed in conformance with appliance and filter manufacturers' instructions.
  - The coarse (“hairy”) side of “hog hair” type shall always face the incoming air.

#### 3. FRAMED FILTER SUPPORTS

- All Unframed Filters
  - Unframed filters shall be supported:
    - As needed to prevent being drawn toward the air handler.
    - In conformance with manufacturer's instructions.
- 1" Bonded Fiber Filters
  - Filters over 20" long in either direction shall be supported with internally installed steel rods (galvanized recommended) to stiffen the filter.
    - Support rods shall be:
      - Adequate gauge to provide the necessary stiffness.
      - Spaced a maximum of 20" on center.

- Sized to fully extend from one edge of the filter to the other.
- Inserted into the coarse filter layer near the netting side of “hog hair” type.
- Inserted in the center of the filter medium, or per manufacturer's instructions, for other types.
- At least one rod shall be positioned so that both ends are supported by a solid surface.
- Other Materials
  - Materials thinner than 1" shall be secured externally.

## 1" BONDED FIBER FILTERS

### 6. “A” SHAPED

- All Filters
  - The HVAC unit shall have:
    - Both upper and lower support devices.
    - Filter access that does not require the removal of any flue, duct, or pipe.
  - A single piece of material shall be used when possible.
  - Filters shall be sized, supported, and installed per Items 4 and 5.
- One-Piece Unframed
  - “Hog Hair” Type
    - The coarse side shall be slit deep enough to facilitate folding the material in an “A” shape.
    - The netting side shall not be cut.
  - Other Bonded Fiber Filters
    - Shall be cut and installed per manufacturer's instructions.
- Two-Piece Unframed
  - Two pieces of material shall be used only when a single larger piece can not be installed.
- Framed
  - Two framed filters of the correct size shall be installed.
  - Larger filters shall not be modified to fit by cutting or folding.

### 7. “V” SHAPED

- All Filters
  - The HVAC unit shall have:
    - A bottom support for the filter.
    - Filter access that does not require the removal of any flue, duct, or pipe.
  - A single piece of material shall be used when possible.

- Filters shall be sized, supported, and installed per Items 4 and 5.
- One-Piece Unframed
  - “Hog Hair” Type
    - A “V” shaped groove shall be cut, as needed, in the coarse side to facilitate folding the material into a “V” shape.
    - The netting side shallnot be cut.
  - Other Bonded Fiber Filters
    - Shall be cut and installed per manufacturer's instructions.
- Two-Piece Unframed
  - Two pieces of material shall be used only when a single larger piece can not be installed.
- Framed
  - Two framed filters of the correct size shall be installed.
  - Larger filters shallnot be modified to fit by cutting or folding.

## 8. HORIZONTAL AND HAMMOCK STYLES

- All Filters
  - Filters shall be sized, supported, and installed per Items 4 and 5.
- Horizontal Unframed
  - Internal support shall be installed as needed.
- Horizontal Framed
  - Internal supportnot required.
- Hammock Style
  - Unframed filters shall be used.
  - Filter shall be secured with the wire mesh hammock.

## 9. VERTICAL

- All Filters
  - Filter shall be sized, supported, and installed per Items 4 and 5.
- Unframed
  - Internal support shall be installed as needed.
- Framed
  - Internal supportnot required.

## 10. RETURN INTAKE GRILLE APPLICATIONS

- All Filters
  - Filters shall be sized, supported, and installed per Items 4 and 5.
- Unframed
  - Internal support shall be installed as needed.

- Framed
  - Internal supportnot required.

**11. WALL FURNACES**

- Filters shallnot be installed on wall furnaces, including models with circulating fans.

**12. TWO FILTERS**

- One Return
  - When two filters exist within the same return path, one shall be eliminated.
  - The most accessible filter shall be replaced with a washable filter.
- Two Returns
  - Each return shall be treated separately as specified above for one return.

**13. WALL/WINDOW MOUNT AIR CONDITIONERS**

- All Filters
  - Filter shall be sized, supported, and installed per Items 4 and 5.
- 1/2" Bonded Fiber Unframed
  - Shall be used whennot prohibited by appliance manufacturer.
- Foam Unframed
  - Shall be installed only when 1/2" bonded fiber:
    - Will not fit properly,or
    - Is prohibited by the appliance manufacturer.



## SECTION 12

### EXTERIOR DOOR AND WINDOW REPLACEMENT STANDARDS

#### 1. REPLACEMENT DOORS

- Wood
  - Conformance to ANSI/NWWDA I.S.1 or IS.6.
- Metal
  - Conformance to ANSI/SDI 100.
  - Minimum 20 minute fire rating.
- All Doors
  - Replacement door must match existing doors: like-for-like.
  - Hinged doors only

#### 2. DIMENSIONS

- Door and Jamb Replacement
  - 1-3/4" door shall be installed.
- Door Replacement (Existing Jamb Kept)
  - 1-3/4" door shall be installed.
  - *Exception:* 1-3/8" door allowed when 1-3/4" will not fit existing jambs.

#### 3. DOOR COMPOSITION

- Veneer
  - Minimum 1/8" thick.
  - Hardboard veneer acceptable.
  - Exterior grade glue recommended.
- Core
  - Solid core required.
  - Foam filled wood doors not allowed.

#### 4. DOOR FINISH

- Wood
  - Shall be sealed on both sides and four edges.
  - Acceptable sealers are:
    - Paint, urethane, and varnish.
    - Water repellent that leaves a visible residue.
- Metal
  - Shall be painted or primed.
  - Oil base or epoxy paint only.

#### 5. HINGE REQUIREMENTS

- All Doors
  - Minimum 3 hinges per door.

- Square or rounded edges acceptable.
- Hinges shall:
  - Conform to ANSI A8133.
  - Be constructed of brass or stainless steel.
  - Be loose-pin type unless mounted toward exterior.
- 1-3/8" Doors
  - Minimum hinge size 3-1/2" x 3-1/2".
- 1-3/4" Doors
  - Minimum hinge size 4" x 4".
- Spring-loaded hinge required between garage and living area

## **6. SCREWS FOR HINGES**

- All Applications
  - Phillips head screws recommended.
- Wood Jamb
  - Brass or stainless steel flathead screws shall be used.
- Metal Jamb
  - Flathead screws shall be used.
- Prehung Units and Replacement Jambs
  - Jamb screws shall be installed.
  - Screws shall penetrate trimmer stud at least 5/8".
- Use of Existing Screw Holes
  - Existing screw holes must be plugged with shims or wood golf tees and glued before reuse.

## **7. HINGE LOCATION**

- All Doors
  - Three hinges required.
  - Lower hinge located 11" from floor.
  - Upper hinge located 7" from upper jamb.
  - Middle-hinge between upper and lower hinges, centered.
  - If jamb is not replaced, existing hinge spacing is acceptable.
  - Mortise holes resulting from hinge relocation must be patched.

## **8. ENTRANCE LOCKSET AND DEADBOLT**

- Entrance Lockset Height
  - Existing height shall be matched if only door is replaced.
  - Lock shall be installed 36" from floor if both door and jamb are replaced.
- Door Replacement
  - Match existing height if door only is replaced.
- Door and Jamb Replacement
  - 3/16" from floor if both door and jamb are replaced.
- Deadbolt
  - Deadbolt shall turn freely.

- Deadbolt shall engage when door is closed and latch tongue is inside strike plate.
- Strike Plate
  - Jamb strike plate required.
  - Latch tongue shall engage properly when door is closed without unusual force.
  - Multiple strike plates not allowed (jamb must be repaired).

## 9. DOOR CLEARANCES

- Stop
  - 1/8" maximum distance between door face and door stop when latchbolt and strikeplate are engaged.
- Jamb
  - 3/16" maximum distance between door edge and jamb.
  - 1/8" minimum distance between door edge and jamb.

## 10. DOOR STOP

- Wood Jambs
  - Stop shall be made of wood.
  - Paint grade acceptable unless existing jamb has natural finish.
  - 5/16" x 1-1/4" minimum dimension.

## 11. DOUBLE STOPS

- All Doors
  - Double stops are not allowed on lock side.

## 12. WINDOW AND DOOR CASING

- Wood
  - Paint grade acceptable unless existing jamb has natural finish.
  - Existing casing shall be matched.
  - Existing miters shall be matched.
  - Exterior grade required in all exterior locations.
- Nails
  - Finishing or casing nails required for interior applications.
  - Galvanized casing nails required for exterior applications.

## 13. DOOR JAMB

- Replacement Material
  - Minimum 3/4" thick.
  - 5/4" stock recommended.
- Corner Joints
  - Top shall be secured to sides with dado or rabbet joints.
  - Width must equal finished wall thickness. (+1/4")

#### **14. DOOR MODIFICATIONS**

- Veneer Type Doors
  - A maximum of 1" may be cut from sides and top and 2" from bottom unless expanded rails and stiles are used.
- All Types
  - Must have 3 to 5 degree bevel required on lockset edge.

#### **15. WARPAGE**

- All Doors
  - Must not have warpage greater than 1/2" from end to end to facilitate proper weatherization.

#### **16. REPLACEMENT WINDOWS**

- Material Requirement
  - Shall be in conformance with one or more of the following:
    - NWWDA I.S. 2-93, 3-95, or 8-95; or ANSI/AAMA 101-93.
    - AAMA/NWWDA 101/I.S.2-97.
  - Shall comply with local code.
- Permanent Label
  - Each unit shall also bear a permanent label which:
    - Lists both (a) the energy performance with rating procedure, and (b) minimum Design Pressure rating, or
    - References the original certification information on file with the Independent Certification and Inspection Agency (IA).
- Replacement Selection
  - Horizontal sliders shall be replaced with horizontal sliders.
  - Vertical sliders shall be replaced with vertical or horizontal sliders.
  - Picture windows shall be replaced with picture windows or sliding windows.
  - Jalousies shall be replaced with vertical or horizontal sliders.
- Insect Screens
  - All openable windows shall be equipped with insect screens.
- Complete House Retrofit
  - Units must also bear a NFRC temporary label
  - U-Value shall be 0.70 or lower

#### **17. Egress Requirements**

- Windows in Bedrooms (Sleeping Rooms)
  - When a sleeping room has no operable exterior door, at least one window shall meet the egress requirements of:
    - Local code, or
    - 1997 UBC, Section 310.4, which places the following requirements on egress windows:
      - Minimum net clearopenable: (a) area of 5.7 f<sup>2</sup>, (b) width of 20", and (c) height of 24".
      - Maximum finished sill height of 44" above the floor.

- When the local jurisdiction does not specify egress requirements, retrofit bedroom windows need not be made to comply with current UBC requirements if the new assembly does not:
  - Reduce the openable dimensions to less than that of the existing assembly, nor
  - Make the window more dangerous to the occupants.

## 18. SAFETY GLASS

- Safety glazing shall be permanently labeled and installed per the 1997 UBC, Section 2406, part of which is summarized below.
- Windows
  - Safety glass is required in any window adjacent to a door where:
    - The nearest vertical edge is within 24" of the door and
    - The bottom edge is less than 60" above the floor.
    - Exception: Not required when there is an intervening wall or other permanent barrier between the door and the glazing.
  - Safety glass is required in panes larger than 9 sq. ft. where:
    - The bottom edge is less than 18" above the floor and
    - The top edge is more than 36" above the floor and
    - A walking surface is within 36" horizontally of the window.
    - Exceptions: As stipulated in the 1997 UBC, Section 2406.4.
  - Safety glass is required in shower and bathtub enclosures for exterior windows less than 60" above the floor of the enclosure.
- Entrance Doors With Glazing
  - Safety glass is required in all doors with glazing.
    - Jalousies not allowed.

## 19. SASH

- Wood
  - Decayed or deteriorated sashes shall be replaced if complete replacement window is not installed.
  - Springs and sash weight systems shall operate properly after sash replacement.

## 20. STRUCTURAL INTEGRITY

- Rough Window Frame
  - All dry rot and pest damage shall be repaired.
  - Damaged structural framing members shall be replaced or repaired before replacing window.

## 21. CAVITY INSULATION

- Wood Framing
  - Open cavities between rough framing and window jamb shall be insulated except where window weights are being utilized.

## **22. EXTERIOR SEAL**

- Flanged Windows
  - Entire window flange shall be caulked prior to installation to ensure watertight seal around perimeter.
- Block Frame Windows
  - Entire exterior perimeter shall be caulked to ensure watertight seal.

## **23. WOOD FINISH**

- All window sashes, frames, and trim shall be sealed or primed.

## **24. ATTACHMENTS**

- Replacement Doors
  - Address numbers present on the existing door or trim shall be reinstalled on the replacement door or trim.
  - Address numbers must be positioned so they are clearly visible from the street.

## **25. POST-INSTALLATION REQUIREMENTS**

- Paint dust and chips, scraps, glass, and other debris resulting from door and window repair and replacement shall be cleaned up and removed from the premises—utilizing lead-safe practices when applicable.
- Furniture and other household items moved for weatherization work shall be returned to normal.

## SECTION 13

### GLASS REPLACEMENT STANDARDS

#### 1. APPROVED MATERIALS\*

- Single Strength (SS)
  - Allowed when DS is too thick for the frame.
  - Maximum pane size: 16 sq. ft.
- Double Strength (DS)
  - Recommended to replace SS when frame thickness is adequate.
  - Maximum pane size: 24 sq. ft.
- 3/16" Plate Glass
  - Maximum pane size: 45 sq. ft.
- 1/4" Plate Glass
  - Maximum pane size: 65 sq. ft.
- Fully Tempered Glass
  - Multiply the above listed sizes by 4.
- Heat Strengthened Glass
  - Multiply the above listed sizes by 2.
- Safety Glass
  - Shall meet the specifications of ANSI Z97.1.
  - Shall be permanently labeled.
- Plastic Materials
  - UV treated polycarbonate, minimum of 1/8" thick
  - All sheeting shall have sufficient rigidity to prevent bowing after installation.
  - Acrylic sheets and plastic film are not allowed.

**\*The listed glass sizing criteria are for installation at locations with low design pressure. For code requirements applicable to other locations, see Chapter 24 of the 1997 UBC or Chapter 24 of the 1998 California Building Code.**

- Jalousie Windows
  - Minimum 3/16" glass shall be installed.
  - Maximum pane length shall be 48".
  - All attachment clips must be present.
  - Regular, patterned, frosted, tempered, and heat strengthened glass allowed.
  - Wired, laminated, and sand blasted glass not allowed.

#### 2. GLAZING COMPOUND

- All Sash Types
  - Glazing compound shall be type that remains pliable.
  - Caulk not allowed.

- Wood Sash
  - Compound shall conform to FS TT-P-00791B.
- Metal Sash
  - Compound shall conform to ASTM C669.
- Aluminum Sash with Vinyl Spline/Gasket
  - Window glazing spline, vinyl push-in gasket, etc., commercially available.
  - Polyurethane caulk may be used for cushion bead and perimeter sealant only when replacement spline/gasket is not available.

### 3. TREATMENT OF SASH

- Wood Sash
  - Shall be treated with linseed oil before glazing compound is installed.
- Metal Sash
  - Shall be painted if rusted or bare.
  - Rust shall be removed before painting.

### 4. PUSH POINTS

- Wood Sash
  - Push points shall be installed:
    - A maximum of 8" apart.
    - Within 4" of each corner.

### 5. SPRING CLIPS

- Metal Sash
  - Spring clips shall be installed:
    - A maximum of 12" apart.
    - Within 4" of each corner.

### 6. SAFETY GLASS

- Safety glazing shall be permanently labeled and installed per the 1997 UBC, Section 2406, part of which is summarized below.
- Windows
  - Safety glass is required in any window adjacent to a door where:
    - The nearest vertical edge is within 24" of the door and
    - The bottom edge is less than 60" above the floor.
    - *Exception:* Not required when there is an intervening wall or other permanent barrier between the door and the glazing.
  - Safety glass is required in panes larger than 9 sq. ft. where:
    - The bottom edge is less than 18" above the floor and
    - The top edge is more than 36" above the floor and
    - A walking surface is within 36" horizontally of the window.
    - *Exceptions:* As stipulated in the 1997 UBC, Section 2406.4.
      - Unless a protective bar exists which is:
        - Located 34" to 38" above the floor.
        - A minimum of 1 ½" in height.



- Capable of withstanding a horizontal load of 50 lbs. Per linear foot without contacting the glass.
- Safety glass is required in shower and bathtub enclosures for exterior windows less than 60" above the floor of the enclosure.
- Entrance Doors With Glazing
  - Safety glass is required in all doors with glazing.
    - *Exceptions:* a) jalousies, and b) those with panes less than 3" in width or height.
- Plastic Glazing
  - Polycarbonate may be used in lieu of safety glass.
  - Shall be UV treated and at least 1/8" thick.

## 7. CUSHION BEAD

- Wood and Metal Sash
  - Cushion bead shall be continuous and free of voids.
- Wood Sash
  - Glazing compound shall be used.
  - Caulk shall not be used.

## 8. FINISH BEAD

- Wood Sash
  - Finish bead shall:
    - Be free of gaps
    - Must be tooled in place and uniform with existing beads as described in Section 1 (Caulking Standards)
    - Not be visible from interior side.

## 9. BATHROOM WINDOWS

- Opaque Glass
  - Replacement glass in bathroom must be opaque if bottom edge of window is less than five feet above finished floor.

## 10. OPERABLE WINDOWS

- Operable windows (movable sashes) shall not be converted to fixed panes.

## 11. REPLACEMENT GLASS

- Replacement glass must equal or exceed the quality of existing glass.

## 12. POST-INSTALLATION REQUIREMENTS

- Paint dust and chips, scraps, glass and other debris resulting from glass replacement shall be cleaned up and removed from the premises – utilizing lead-safe practices when applicable.
- Furniture and other household items moved for weatherization work shall be returned to normal.

## SECTION 14

### SCREW-IN COMPACT FLUORESCENT LAMP STANDARDS

#### 1. MATERIALS

- Must be UL listed and meet ANSI/UL Standard 935 Class-P.
- Must meet the ANSI C78.5-1997 standard.
- CFL tube glass and other housing materials must be UV resistant and heat stable.
- The CFL tube glass and its connection to the housing and base shall be sufficiently sturdy and resistant to twisting to remain intact without any loosening of connections after installations and removals.
- CFLs shall operate with a minimum efficacy of 60 lumens/watt.
- CFLs must be fully warranted for one year from date of purchase.

#### 2. COMPACT FLUORESCENT BALLASTS

- Must be UL listed.
- Must meet the ANSI C82.11-1993 standard.
- Must be fully enclosed.
- Ballasts (<30 watts) shall:
  - Have a minimum power factor of 90% (0.9 true) (ANSI C78.375).
  - Have a THD rating less than 33% (ANSI C78.375).
  - Be rated to operate in temperature range of 0° to 140°F.

#### 3. INSTALLATION

- All Types
  - All lamps, without exception, shall be installed by the contractor.
  - Only incandescent lamps shall be replaced.
  - Manufacturer's recommendations shall be followed.

#### 4. LUMENS

- All Types
  - Replacement CFLs must provide light output (lumens) levels sufficient to maintain pre-existing levels.

Existing		Recommended CFL Replacement	
Lamp Wattage	Lumen Output	Lamp Wattage	Min. Lumen Output
25	375	9	430
40	500	11	600
50	800	15	900
60	900	15 – 18	900
75	1200	18 – 20	900 -1200
90	1550	23	1380 -1500
100	1650	27	1750

## 5. LOCATIONS

- All Types
  - Screw-in CFLs shall be installed in outdoor locations only if protected from the weather (e.g., on porch or in garage) and installed in a fixture rated for wet and damp locations.

## 6. TABLE LAMPS

- Shades
  - Harp extensions or expanders shall be installed when needed.
  - The harp shall expand to fit snugly.
- Height Limitation
  - The height of the lamp shall not exceed 3 times the width of the base.

## 7. FIELD TESTING

- All Types
  - The installer shall:
    - Test all installed fluorescent lamps before leaving.
    - Ask the customer if the lighting level is adequate.

## 8. CLUSTER LIGHTING

- All Types
  - CFLs shall not be installed in chandeliers or other cluster lighting fixtures unless the CFL is specifically designed for such applications.

## 9. DIMMERS, PHOTOSENSORS, AND OCCUPANCY SENSORS

- All Types
  - Only CFLs rated for use with dimmers, photosensors, and occupancy sensors shall be installed in fixtures controlled by such devices.

## 10. TIMERS

- Mechanical
  - CFLs may be installed in fixtures equipped with mechanical timers.
- Solid State
  - CFLs shall not be installed in fixtures equipped with solid state timers.

## 11. LAMP CORD SUPPORTED

- All Types
  - CFLs shall not be installed in fixtures supported only by a lamp cord unless the manufacturer allows the use of CFLs in such fixtures.

## 12. MISSING CAPS

- Porcelain Bases
  - CFLs shall not be installed in lamp bases with missing caps.

### **13. HAZARDOUS CONDITIONS**

- All Types
  - CFLs shall not be installed in fixtures with hazardous conditions, such as:
    - broken fixture components
    - bare wires or missing wire nuts
    - unsecured fixtures

## SECTION 15

### HARD-WIRED FLUORESCENT FIXTURE INSTALLATION STANDARDS

#### COMPACT FLUORESCENT FIXTURES

##### 1. MATERIALS

- Must be UL listed and meet ANSI/UL Standard 935 Class-P.
- CFL tube glass and other housing materials must be UV resistant and heat stable.
- Compact fluorescent lamps shall operate with a minimum efficacy of 60 lumens/watt.
- Hardwired fixtures and lamps must be fully warranted for one year from date of purchase.
- Fixture must allow for lamp replacement.

##### 2. COMPACT FLUORESCENT BALLASTS

- Must be UL listed.
- Must meet the ANSI C82.11-1993 standard.
- Ballasts (<30 watts) shall:
  - Have a minimum power factor of 90% (0.9 true) (ANSI C78.375).
  - Have a THD rating less than 33% (ANSI C78.375).
  - Be rated to operate in temperature range of 0°F to 140°F.

##### 3. INSTALLATION

- Must be installed in accordance with the current NEC and local codes.
- Shall be installed to prevent water from entering or accumulating in wiring compartment, lamp holder or electrical parts.

##### 4. LOCATION

- Fixtures may be installed:
  - In wet locations, if fixtures are rated for wet locations.
  - In damp locations, provided fixtures are rated for damp locations and are out of direct contact with precipitation, in partially protected locations (e.g., under canopies, marquees, and open porch roofs).
- Fixtures may not be installed in:
  - Locations exposed to harmful gases, fumes, vapors, or other deteriorating agents unless the fixture is rated for hazardous or vaporous locations.

##### 5. SUPPORT

- The fixture shall be:
  - Attached to a properly installed electrical box.
  - Secured to the box with at least two screws.

##### 6. VOLTAGE REQUIREMENT

- Fixtures shall be installed only in 110-120 volt circuits.

## **7. GROUNDING**

- The fixture shall be properly grounded as prescribed by manufacturer's instructions and the NEC.

## **8. SPLICING CONNECTORS**

- All connections shall be secured with properly sized wire nuts (pressure splicing connectors).
- If those provided with the fixture are not satisfactory, the installer shall provide the correct size.

## **9. TAPE**

- Tape may be used only as a supplement to wire nuts, but not to ensure attachment.

## **10. DISSIMILAR METALS**

- Aluminum and copper wires shall not be spliced together.

## **11. DIMMERS, PHOTOSENSORS, AND OCCUPANCY SENSORS**

- All Types
  - Only CFLs rated for use with dimmers, photosensors, and occupancy sensors shall be installed on circuits controlled by such devices.
  - Only a dimmer conforming to the specifications of the lamp manufacturer shall be used to dim CFL fixtures.

## STANDARD FLUORESCENT FIXTURES

### **12. MATERIALS**

- Must be UL listed.
- Must be UV resistant and heat stable.
- Must be certified to meet CEC minimum energy efficiency and BEF standards.

### **13. EXTERIOR FIXTURES**

- Fixtures marked "Suitable for Damp Locations" may be installed outdoors, out of direct contact with precipitation, in partially protected locations (e.g., under canopies, open porch roofs, and carports).
- Fixtures marked "Suitable for Wet Locations" may be:
  - Installed in unprotected outdoor locations more than 4' above the ground.
  - Exposed to precipitation and/or sprinklers.
  - Installed in damp locations.
- All wiring, conduit, accessories, fasteners, and controls used in exterior locations shall be designed for exterior use.

### **14. FLUORESCENT LAMPS**

- All lamps shall conform to ANSI C-78.
- Lamps shall operate with either 1) energy-saver, cathode filament cutout electromagnetic ballasts (hybrid) or 2) electronic ballasts.
- Be free of broken, loose, or bent pins.

- Be correctly matched with appropriate ballasts.
- Lamp Environment
  - Lamps shall be:
    - Appropriate for the ambient temperature.
    - Operated within their specified temperature limits.
- Lamp Coverings
  - Lamps shall be covered with plastic lamp sleeves, enclosures, or lenses when:
    - Recommended by manufacturer.
    - Required by code.

## 15. BALLASTS

- All ballasts shall be:
  - UL listed.
  - CBM certified.
  - In compliance with FCC Rules and Regulations, Part 18 regarding EMF and RF interference.
- Warranty
  - Both labor and materials shall be covered.
  - Defects shall be covered for a minimum of 5 years.
- High-efficiency fluorescent ballasts shall:
  - Operate straight and U-tube fluorescent lamps.
  - Provide constant light output with input voltage between 110 – 126 volts (120-volt units).
  - Have a minimum Class A sound level rating (20-24 dB).
  - Not exceed 90°C at ballast case hot spots.
- Electronic ballasts shall:
  - Operate at a frequency of 20 kHz or higher.
  - Be rated to operate normally at plus-or-minus 10% of nominal input service voltage.
- Dimming Ballasts
  - Ballast shall dim continuously from 100% to 10% output or lower if needed or requested by customer.
  - All ballasts used in dimming applications shall:
    - Be approved by manufacturer for dimming.
    - Use controllers approved by the ballast manufacturer.
  - Electronic dimming ballasts:
    - Three- or four-wire control configurations are acceptable.

## 16. GENERAL INSTALLATION

- All New and Retrofit Installations
  - Installations shall comply with:
    - All applicable provisions of law, regulations, and all local codes.

- The most recently adopted and approved NEC.
- Installation shall not damage, disable, alter, or result in the removal of any existing emergency lighting fixtures, lamps, inverters, standby generators, batteries, controls, etc.
- Securing Fixtures
  - All exterior fixtures shall be securely fastened.
    - At least two fastening points are required (e.g., nipple plus screw, bolt or other anchor).
    - Single-nipple fastening alone is not acceptable.
- Wiring
  - Shall comply with the most recently adopted and approved NEC.
  - Shall be bundled and neatly installed clear of lamps, ballast cover edges, reflectors, etc. in all retrofitted/rebuilt fixtures.
  - Wiring shall not be damaged (e.g., no slices, cuts, nicks or other damage).
  - Splices shall be contained within a fixture, ballast cover, junction box, etc.
  - Wire Connectors
    - Be UL listed.
    - Only new wire nuts shall be used.
    - Wire nuts shall be properly sized (type, size, and number of wires).
    - Pre-twisting of wires required when specified by wire nut manufacturer or local jurisdiction.
    - All wire nuts shall be firmly twisted.
    - “Poke-in” and “stab-in” type electrical connections may be used in lieu of wire nuts when suggested by manufacturer's instructions.
    - Wire shall be stripped to proper length per wire connection specification.
- Grounding
  - Fixtures shall be grounded in compliance with manufacturer’s specifications and the NEC.
  - All metallic fixture parts shall be grounded to the building’s ground system.
  - Metal-to-metal contact shall be achieved when connecting bare ground; paint, drywall mud, etc. shall be removed from wire leads, boxes and plates as needed.
  - Rows of fixtures shall maintain consistent grounding.
  - Grounding conductor shall extend from fixtures to main building ground (must maintain continuity).