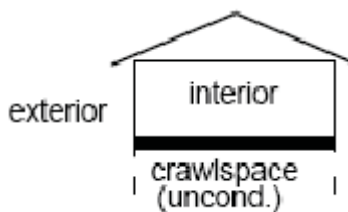


## A.2 On-Site Inspection Protocols<sup>1</sup>

ACM Section	Task	On-Site Inspection Protocol
3.3.1 Building Zone Information	Determine number of stories and bedrooms	Record the number of stories of the house as defined by the <i>California Building Code</i> .
	Determine number of bedrooms	Record the number of bedrooms in the house. Bedroom: any space in the conditioned area of a dwelling unit or accessory structure which is 70 square feet and greater in size and which is located along an exterior wall, but not including the following: hall; bathroom; kitchen; living room (maximum of one per dwelling unit); dining room (in proximity to kitchen, maximum of one per dwelling unit); family room (maximum of one per dwelling unit); laundry room, closet/dressing room opening off of a bedroom. A bedroom must have a window with minimum dimensions for egress and a door that closes.
	Measure floor dimensions	<p>Measure floor dimensions in accordance with ANSI Z765-2003.</p> <p>For conditioned basements and crawl spaces, find dimensions of basement walls and floor. Divide walls into above and below grade sections.</p> <p>Measure the floor to the nearest inch, and record the square footage to the nearest square foot. Use exterior measurements; those measurements should start at the exterior finished surface of the outside wall. Openings to the floor below should not be included in the square footage calculation, with the exception of stairways; stairways and associated landings are counted as square footage on both the starting and ending levels. Do not include the “footprint” of protruding chimneys or bay windows. Do include the “footprint” of other protrusions like a cantilever when it includes finished floor area. Do include the square footage of separate finished areas that are connected to the main body of the house by conditioned hallways or stairways.</p>
	Determine conditioned volume of space	Determine conditioned and indirectly conditioned volume of space by multiplying conditioned floor area by ceiling height. The house may need to be split into different spaces with different ceiling heights and added to each other for both conditioned and indirectly conditioned spaces. For areas with vaulted ceilings, volume must be calculated geometrically.
	Identify Crawlspace	<p>A crawl space is typically defined as a foundation condition with a clear vertical dimension 4 feet high or less. Crawl spaces are either vented or have controlled ventilation as described in the 2008 Residential ACM Manual.</p> <p><b>Vented crawl spaces</b> have some form of vent or louver in the crawl space walls, or are constructed in such a manner so that air moves freely from outside the walls to inside the crawl space.</p> <p><b>Controlled ventilation crawl</b> spaces have insulation installed in the side walls of the crawlspace, instead of in the floor, which separates conditioned space from the crawlspace. In addition, special dampers in the foundation vents are installed that are used to provide the required ventilation for the crawlspace, which automatically open when it is warm and close when it is cold.</p>



<sup>1</sup> Adapted from National Home Energy Rating Technical Guidelines, December 28, 2005, Appendix A, On-Site Inspection Procedures for Minimum Rated Features, which was excerpted from: Guidelines for Uniformity: Voluntary Procedures for Home Energy Ratings, Version 2.0, Home Energy Rating Systems Council (HERSC), August 1996.

ACM Section	Task	On-Site Inspection Protocol
	Determine whether basement is unconditioned or directly or indirectly conditioned.	<p>A full basement has characteristics similar to an unvented crawl space, except that the clear vertical dimension is typically greater than 4 feet. Stairs that lead from the main floor to a below grade space are an indication of a basement in a house.</p> <p>To determine whether a basement is conditioned, assess the insulation placement in the walls or floor/ceiling assembly. A basement may be considered either unconditioned or directly or indirectly conditioned based on the following criteria:</p> <ul style="list-style-type: none"> <li>• <b>Unconditioned</b> -The basement is not intentionally heated or cooled and the floor/ceiling assembly between the basement and the conditioned space above is insulated, Typically, any heating or plumbing distribution systems in the space is insulated.</li> <li>• <b>Conditioned, directly or indirectly</b> – Either the basement is intentionally heated and/or cooled or the floor/ceiling assembly between the basement and the conditioned space above is uninsulated. Foundation walls are insulated or uninsulated.</li> </ul> <p>If the basement is either directly or indirectly conditioned, then it shall be considered part of the conditioned floor area and volume of the house.</p>
3.3.2 Thermal Mass	General	<p>Thermal mass systems consist of solar-exposed heavyweight materials with high heat capacitance and relatively high conductance (high thermal diffusivity) such as masonry, brick, concrete, tile, stone. These elements may be integral with the building or distinct elements within the building. “Heavy” mass includes elements such as concrete slab floors, masonry walls, double gypsum board, Trombé walls and other special mass elements.</p> <p>A building is considered to have a high thermal mass if it: has mass equivalent to 30% of the conditioned slab floor area being exposed slab and 70% slab covered by carpet or casework, and 15% of the conditioned non-slab floor area being exposed with two inch thick concrete with the remainder low-mass wood construction.</p>
	Determine the inside surface condition of slab on grade floors (exposed or covered)	<p>For slabs on grade, determine the percentage that is exposed and covered. Exposed slabs provide more effective thermal mass.</p> <ul style="list-style-type: none"> <li>• <b>Covered</b> -If floor is covered with wall-to-wall carpet, consider it covered. Floors with only area rugs are not considered covered. The default is 80% covered.</li> <li>• <b>Exposed</b> -If the floor has tile, linoleum or wood, consider it exposed. The default is 20% exposed.</li> </ul> <p>In special circumstances, the determination may be made separately for the perimeter portion of the slab and the interior portion. The perimeter is that portion within 2 ft from the exterior wall.</p>
	Determine the Interior Mass Capacity for other (non-slab) mass elements	<p>Other features or components of the home can increase the thermal mass. These include concrete toppings on raised floors, double drywall or thick plaster finishes, tile set in mortar, and interior mass walls. The mass contribution of these additional mass elements may be accounted for using Interior Mass Capacity method from Standards Reference Appendix RA5. Using this approach, identify the surface area of all qualifying mass elements from RA5. The interior mass capacity (IMC) is the sum of the product of the assembly areas and UIMC.</p>
3.3.3 Natural Ventilation and Infiltration	Determine Natural Ventilation Area	<p>The default assumption is that all windows are sliders and that they have a free ventilation area equal to 10% of their total rough opening area. If a large fraction of hinged windows are used, then the areas of the three basic window types, slider, fixed, and hinged should be determined and entered into the HERS software tool to account for larger free ventilation area and take advantage of the natural ventilation cooling calculated in the software.</p>
	Determine Ventilation Height Difference	<p>The default assumption for the proposed design is 2 ft for one story buildings and 8 ft for two or more stories. Greater height differences may be used with special ventilation features such as high, operable clerestory windows. In this case, the height difference entered by the user is the height between the average center height of the lower operable windows and the average center height of the upper operable windows.</p>
	Determine presence of air retarding wrap	<p>For newly constructed buildings, determine whether or not an air retarding wrap is present. An air retarding wrap must meet specifications of ASTM E1677-95, Standard Specification for an Air Retarder (AR) Material or system for Low-Rise Framed Building Walls, and have a minimum perm rating of 10. Polymer-based housewraps are available that meet the minimum perm requirement. Building paper that is used as a weather resistive barrier will not meet this requirement.</p> <p>For recently constructed buildings, the presence of an air retarding wrap should be documented on the special features section of the CF-1R form.</p>
	Determine presence of sealed ducts	<p>A credit for reduced infiltration may also be taken for sealed and tested ducts for ducted systems. Refer to the test procedure in Reference Appendix RA3-2008 for measurement of duct leakage.</p> <p>For reduced infiltration credit for existing duct systems, duct leakage must be tested and be at or below 6% of total fan flow.</p> <p>This credit may also be taken for recently sealed duct systems if the documentation for the duct sealing by a HERS rater indicates that the duct leakage is 6% or less of total fan flow.</p>

ACM Section	Task	On-Site Inspection Protocol
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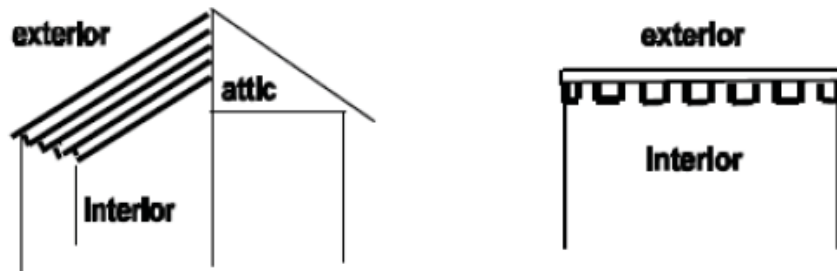
	Determine specific leakage area from a blower door test	Credit for reduced air infiltration may be taken by using the testing protocol described in ASTM E 779-03, Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
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3.4.1 Roof Pitch and Attic Geometry	Determine roof pitch	<p>Roof pitch: rise over run (as in 4:12). One approximate method of measuring the pitch is with a level. The measurements are taken from on top of the roof. Simply mark a level at 12", hold it perfectly level and measure from the roof surface to your 12" mark, this will give you the rise. Be careful with this method as a roof with many layers of shingles, or any type of roofing that is irregular can give you less than precise results.</p> <p>A more accurate method is to measure the pitch from the underside of the rafters. To use this method there are 3 possible places to take your measurements: the underside of a barge rafter on a gable end, the underside of a rafter on an overhang at the bottom of the roof, or the underside of a rafter in the attic.</p> <p>Another alternative is to use a framing square. Point the long end of the L towards the roof and the short end towards the ground. Position the framing square so that the long end hits the roof at the 12 inch mark. Level the square horizontally and measure the vertical rise (the short leg) in inches.</p> <p>A carpenter's "square" has a first member with a level so it can be held horizontal with one end elevated above a pitched roof, while the opposite end rests on the roof exactly 12 inches from the inside edge of a vertically movable member supported in the first member, and clamped to it by a thumb screw. This inside edge is graduated inches to read out roof pitch directly in "inches per foot".</p>
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3.4.2 Ceiling/Framing Assembly	Measure the area of all ceiling surfaces	<p>Measure the linear perimeter dimensions of the ceiling area to the nearest 1/2 foot and use these measurements to calculate surface area of the ceiling. If a ceiling area is vaulted, it may be necessary to calculate dimensions geometrically. Identify the ceiling as: next to attic, exposed beams or rafters, or finished framed ceiling. See the descriptions below:</p> <p><b>Ceiling next to attic</b> - If the ceiling has attic space above (even if the ceiling is vaulted, as in a scissor truss) it is considered a ceiling next to attic. If there is a vaulted ceiling check its angle against the angle of the roof -- if the ceiling angle is gentler there is attic space above the ceiling. Also check for an attic access, either separate or from an attic over another part of the house.</p>
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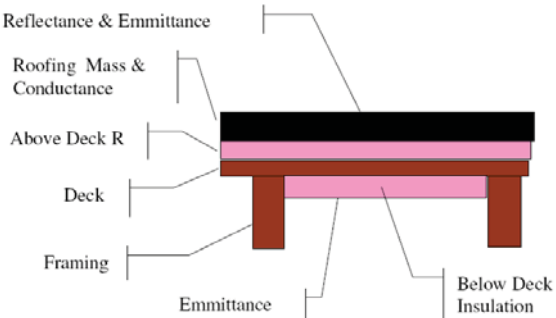


**Exposed beams or rafters** - when you look up from inside the room, you will see exposed beams or rafters.




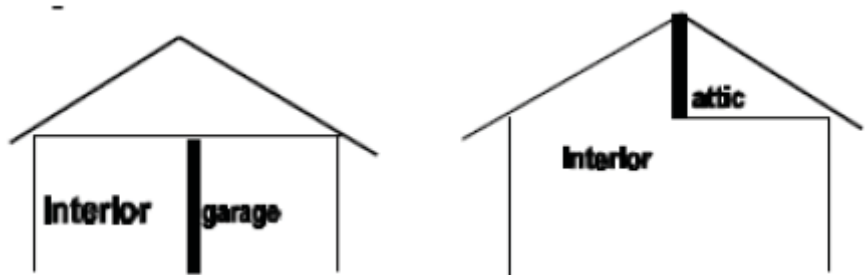
**Finished framed ceiling with no attic** - if the ceiling is framed (has no attic space above it, but you cannot see the rafters because the ceiling is finished with drywall, plaster, paneling, etc.) consider it a finished framed ceiling with no attic.



ACM Section	Task	On-Site Inspection Protocol
3.4.2 Ceiling/Framing Assembly	Determine R-value of the ceiling insulation	<p>To determine the insulation R-value which exists in the ceiling area (cavity):</p> <ul style="list-style-type: none"> <li>Measure the depth of the insulation in four places and take the average; if the depth in one section of the attic is different by 2 inches or more than other areas, measure the depth for the areas separately or use the least depth for the whole attic;</li> <li>Determine the type of ceiling insulation present (may be a combination of more than one type);</li> <li>Multiply the R-value per inch of the material by the depth of the insulation;</li> </ul> <p>Use an R-value per inch of 3.85 for fiberglass blankets or batts, 3.41 for loose-fill cellulose, 2.13 for vermiculite, 3.85 for expanded polystyrene (EPS) rigid boards. Use R-11 for 3.75-5 inches of mineral fiber (rock, slag or glass), R-19 for 6.5 to 8.75 inches of mineral fiber, R-22 for 7.5 to 10 inches, and R-30 for 10.25 inches or greater.</p>
	Determine the type and spacing of the framing	<p>Determine the framing member type and spacing for framed ceilings exposed to unconditioned spaces.</p> <p>Check the framing by looking from the attic access or by looking at the rafters from the outside where they protrude from the eave.</p>
	Select Construction from Joint Appendix 4	<p>Select the U-factor from the Table 4.2.1 or Table 4.2.4 of Reference Appendix JA4 that corresponds to the framing size and spacing and insulation level in the attic. In most cases, a value will be chosen from column A of the table.</p> <p>If there is no access to the framed ceiling, ask the customer for documentation of insulation or use a default value based on age based on Table 3-50 of the Residential ACM Manual.</p>
	Determine Insulation Quality	<p>A credit is offered in the HERS software for ceiling, wall, and floor assemblies that meet the insulation quality standards. Determine the insulation installation quality meets the requirements of Reference Appendix RA3-2008, section 3.5. To qualify for the Insulation Quality Standards credit ALL insulation in ceilings, walls, and raised floors must meet the insulation quality requirements. Generally this credit cannot be taken separately for walls, ceilings, or raised floors nor for parts of walls, ceilings, or raised floors.</p>
3.4.3 Attic Ventilation	Determine the free ventilation area	<p>Ventilation area: free ventilation area / attic floor area (ex: 1/300). Measure the area of each ventilation grille and assume that 60% of the area of the grille is free ventilation area for 3/8ths inch mesh. Note that newly installed soffit vents must meet California Fire Code requirements in Wildland Urban Interface areas and will have smaller free ventilation area factors. Divide the total free ventilation area by the floor area of the attic.</p>
	Determine the percent of ventilation area located high	<p>Fraction ventilation high – the fraction of the free ventilation area that is located high in the attic due to the presence of ridge, roof or gable end mounted vents. Ventilation is considered high if it is within 2 feet of the highest point in the attic. Soffit vents are considered low ventilation.</p>
3.4.4 Roof Deck above Attic		
	Determine solar reflectance and emittance	<p>For asphalt shingles or composition shingles, the default aged solar reflectance is 0.08. The default aged solar reflectance for other roofing materials is 0.10. The default emittance for all materials except unpainted metal roofing is 0.85.</p> <p>For products rated by the CRRC, the aged reflectance and emittance shall be used. If the aged reflectance is not available from the CRRC, it shall be estimated by multiplying the initial reflectance by 0.70 and adding 0.06. The aged emittance shall be equal to the initial emittance.</p> <p>For existing homes, the solar reflectance is assumed to be one of the default values unless it is measured. The solar reflectance can be measured for low-sloped surfaces using a pyranometer, following the ASTM E1918-06 Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.</p>
	Determine the roof type	<p>Identify the type of roofing surface. The user chooses from: concrete or clay tile; metal tile or wood shakes; other high slope roofing types (including asphalt and composite shingles and tapered cedar shingles); or low slope membranes (a rise to run ratio of 2:12 or less).</p>

ACM Section	Task	On-Site Inspection Protocol
	Determine above deck insulation	Above deck R-value – R-value of insulation above the roof deck (the default is no insulation) Use the R-value per inch times the thickness of the rigid insulation installed.
	Determine roof mass	Roofing mass – choose from: normal gravel, concrete tile, heavy ballast or pavers, very heavy ballast or pavers, or all other roofing.
	Determine depth of framing	Frame depth – depth of framing attached to the roof deck
	Check for radiant barrier	Radiant barrier – whether or not a radiant barrier is present (Yes/No)
	Determine below deck insulation	Below deck R – R-value of the insulation at the bottom of the roof deck between the framing
	Determine roof deck framing spacing	The roof deck framing is either 24” o.c. or 16” o.c.
	Check insulation installation quality	Insulation installation quality – determine if the ceiling insulation meets the quality installation requirements in Reference Appendix RA3, section RA3.5. To qualify for the Insulation Quality Standards credit, ALL insulation in ceilings, walls, and raised floors must meet the insulation quality requirements. Generally this credit cannot be taken separately for walls, ceilings, or raised floors nor for parts of walls, ceilings, or raised floors.
	Check ceiling framing	The ceiling framing is either 24” o.c. or 16” o.c.

3.5.1 Non-Attic Ceiling and Roof Constructions	Determine surface area	Determine the surface area of the ceiling in the same manner as in section 3.4.2.
	Determine orientation and tilt	Determine the orientation by taking a compass reading (adjusted for magnetic deviation) in the direction toward which the roof surface faces. Determine the roof pitch (such as 4:12) by the procedures in section 3.4.1.
	Determine the assembly U-factor	Determine the assembly U-factor by measuring the depth of the insulation and the framing thickness. Assume an R-value per inch of 3.85 for fiberglass, 3.41 for cellulose, 3.85 for rigid expanded polystyrene (EPS), 6.25 for rigid polyisocyanurate insulation, 2.13 for vermiculite. Lookup the assembly U-factor in Table 4.2.2 of Reference Appendix JA4 for wood-framed rafter roofs, Table 4.2.3 for SIP (foam core panel) roofs, Table 4.2.5 for metal framed rafter roofs.
	Check insulation installation quality	Insulation installation quality – determine if the insulation meets the quality installation requirements in Reference Appendix RA3, section RA3.5 or JA7 for foam installation. To qualify for the Insulation Quality Standards credit, ALL insulation in ceilings, walls, and raised floors must meet the insulation quality requirements. Generally this credit cannot be taken separately for walls, ceilings, or raised floors nor for parts of walls, ceilings, or raised floors.

3.5.2 Exterior Walls	Determine whether walls border exterior space, attic, garage or crawl space	Wall to exterior -Walls border exterior space.
		 <p>Diagram showing a house cross-section with a central vertical wall. The area to the left of the wall is labeled 'exterior', the area to the right is labeled 'exterior', and the area between the wall and the roof is labeled 'Interior'.</p>
		Wall to enclosed unconditioned space -Walls that border unconditioned attics, garages and crawl spaces.
		 <p>Two diagrams showing house cross-sections. The left diagram shows a house with a central vertical wall separating the 'Interior' from a 'garage'. The right diagram shows a house with a vertical wall separating the 'Interior' from an 'attic' space.</p>

ACM Section	Task	On-Site Inspection Protocol
	Determine wall orientation	Determine the orientation of each exterior wall using a compass adjusted for magnetic deviation.
	Determine surface area of all walls exposed to unconditioned space	Measure linear perimeter of the walls to the nearest 1/2 foot. Measure the interior wall height of the walls to the nearest 1/4 foot. Use these measurements to calculate surface area. Exclude surface area of any windows (including the window frame) when making the wall area measurement.
	Determine the structural system of walls	<p>Wood framing -is very common in residential construction. Wood studs are located 16" or 24" on center all along the wall. Knocking on the wall will give a "hollow" sound in the cavities between the studs and a "solid" sound at the stud locations.</p> <p>Metal framing -can be found in some newer residential construction. A strong magnet slid against the wall will hold to metal framing. Also check inside the attic at the edges for evidence of metal wall framing.</p> <p>Masonry walls - include walls constructed of concrete or brick. A wood framed wall with brick veneer would not be considered a masonry wall. Also note insulated siding or insulated finish materials on the wall.</p> <p>Foam core walls (SIPs) - are a sandwich panel consisting of a foam center with outer layers of structural sheathing, gypsum board or outer finish materials. Foam core panels may be structural (load bearing) or non-structural. Non-structural panels are frequently used in post and beam construction.</p> <p>Log walls - are typically solid wood walls, using either milled or rough logs or solid timbers. Some homes may have the appearance of solid log walls, yet may actually be wood frame walls with siding that looks like solid logs inside and out. Some log walls are manufactured with insulated cores. Unless manufacturer's documentation is available or visual inspection of insulation type and thickness can be made, assume no added insulation exists in a log wall.</p>
	Determine framing member size for all framed walls exposed to unconditioned space	<p>To determine whether 2x4 or 2x6 framing exists:</p> <p>Measure the depth of the window jambs;</p> <p>Subtract the thicknesses of the wall coverings and sheathing materials (approximately .25" to 1.0" for stucco, .5" to .6" for interior sheetrock, and .5" to .75" for other exterior siding materials);</p> <p>Compare the remaining width to 3.5" for a 2x4 wall or 5.5" for a 2x6 wall;</p> <p>If exposed garage walls exist, examine them for reference (although they will not always be the same as other walls);</p> <p>If a wall does not come close to the framing width of a 2x4 or 2x6, inspect for foam sheathing on the inside or outside of the walls. In super-insulated construction, "double stud," or "strapped" walls may account for thickness greater than 5.5 inches. For brick veneer walls, assume 4.5" - 5" for brick, airspace and sheathing material.</p> <p>Check the framing member size on all sides of the house. If an addition has been added, be sure to check the walls of the addition separately. If the house has more than one story, check the framing member size for each floor.</p>
	Determine type and thickness of existing insulation and resultant U-factor	<p><b>Framed Walls</b></p> <p>Check at plumbing outlet under sink or, in order of preference, remove cable outlet plate, telephone plate, electrical switch plates and/or electrical outlet plates on exterior walls.</p> <p>Probe the cavity around the exposed plate with a non-metal device (such as a plastic crochet hook or wooden skewer). Determine type of insulation (fiberglass, cellulose insulation, foam, etc.). Inspect outlets/switch plates on each side of the house to verify that all walls are insulated.</p> <p>For wood framed walls, determine the U-factor based on the insulation level (batt or foamed) and the presence of insulated sheathing, as documented in Table 4.3.1 of Reference Appendix JA4. In most cases, a value will be chosen from column A of this table.</p> <p>For metal framed walls, select a U-factor corresponding to the assembly framing thickness, cavity and continuous insulation levels and framing spacing from Table 4.3.4 of Reference Appendix JA4.</p> <p>For foam core walls (SIPs), select a U-factor corresponding to the appropriate assembly in Table 4.3.2 of Reference Appendix JA4. The value is chosen based on the insulation level of the core. Values are presented for both EPS (expanded polystyrene panels) and polyiso (polyisocyanurate) panels. (Assume an insulation R-value per inch of 3.85 for EPS. For polyiso core panels, insulation R-values of R-26 and R-40 are present for 4.5" and 6.5" panels, respectively.)</p> <p>For log walls, select a U-factor based on the log thickness from Table 4.3.11 of Reference Appendix JA4.</p> <p>Parts of the house that were added later must be checked separately from the original walls.</p> <p><b>Sheathing</b></p> <p>Insulated sheathing may exist on walls, but can be difficult to verify. Walls with insulated sheathing may be thicker than walls without insulated sheathing. Visual verification of insulated sheathing may be found in the attic at the top of the wall, exterior wall penetrations, and at the connection between the foundation and the wall.</p> <p>Determine the thickness of the sheathing and resulting R-value, and use this with the cavity insulation R-value to determine the assembly U-factor from the Tables in Reference Appendix JA4.</p>

ACM Section	Task	On-Site Inspection Protocol
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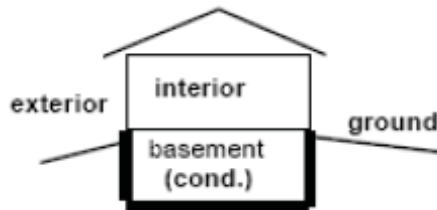
Determine insulation value	<p>The rim joist is installed around the perimeter of the floor joists over a basement or crawl space, or between 2 stories of a house.</p> <p><b>Crawl space or Basement</b></p> <p>From the basement or crawl space, visually identify and measure the depth of insulation at the rim joist. The insulation used is generally fiberglass batts, often folded in an L-shape and attached to the rim joist. Rigid board insulation may also be found. Insulation value</p> <p><b>Between Stories</b></p> <p>Look for access to the area from a garage or a utility access trap door. Visually identify and measure insulation if it exists. If no access can be found, assume insulation exists at the rim joist between stories if insulation was found at the rim joist at the top of the crawl space or basement in the same house.</p> <p>Otherwise, assume no rim joist insulation exists.</p>
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Check insulation installation quality	<p>Insulation installation quality – determine if the insulation meets the quality installation requirements in Reference Appendix RA3, section RA3.5 or JA7 for foam insulation. To qualify for the Insulation Quality Standards credit, ALL insulation in ceilings, walls, and raised floors must meet the insulation quality requirements. Generally this credit cannot be taken separately for walls, ceilings, or raised floors nor for parts of walls, ceilings, or raised floors.</p>
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Determine type and thickness of all mass walls	<p>If the dwelling's walls are constructed of concrete, masonry or brick, determine their type and thickness.</p> <p>Solid concrete walls (poured) – Determine the U-factor based on Table 4.3.6, row 5 of Reference Appendix JA4. Measure the thickness of the poured concrete wall in inches.</p> <p>Concrete Masonry Unit – Determine the U-factor based on the wall thickness and the density (105 lb/ft<sup>3</sup> for lightweight CMU, 115 lb/ft<sup>3</sup> for medium-weight CMU and 125 lb/ft<sup>3</sup> for heavyweight CMU) from Table 4.3.6 of Reference Appendix JA4.</p> <p>Cinder block or uninsulated concrete wall - hollow in the middle. Determine the U-factor based on Table 4.3.5 of Reference Appendix JA4. Check for additional insulation (interior furring, foam board, foam fill). Since grouting cells affects thermal performance, data is provided for three cases: where every cell is grouted (Column A), where the cells are partially grouted and the remaining cells are left empty (Column B), and where the cells are partially grouted and the remaining cells are filled with perlite or some other insulating material (Column C). Measure the thickness of the wall in inches.</p> <p>If interior furring insulation is present, look up the effective R value from Table 4.3.13 of Reference Appendix JA4. Use the equation 4-1 from JA4 to add the effective R-value of the interior/exterior furring to the U-factor.</p>
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3.5.3 Basement Walls and Floors	Determine area of basement walls	<p>Portions of basement walls above grade shall be considered conventional above-grade walls. For below-grade basement walls, measure the area at each of three depth ranges: from zero to 2 feet below grade (shallow), greater than 2 feet to 6 feet below grade (medium), and greater than 6 feet below grade (deep).</p>
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Determine insulation in walls and floor of conditioned basement or crawl space	<p>If basement or crawl space is determined to be conditioned, its walls and floor are considered part of the building envelope. (The floor between the house's ground floor and the basement or crawl space is considered an interior boundary with no associated heat transfer calculated.)</p>
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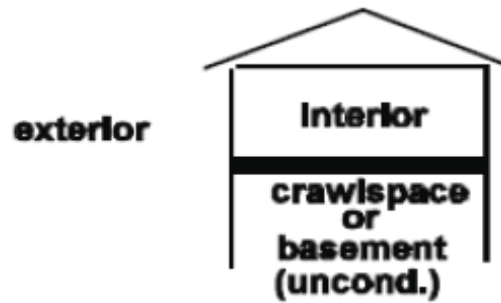
Determine insulation type, thickness and R-value in walls. Wall insulation may be located inside foundation wall (studs and batts, foam under drywall, etc.), integral with foundation wall (insulated cores of block wall, insulating concrete block such as insulating formwork) or outside the foundation wall (rigid foam insulation).

Choose a U-factor for the basement floor from Reference Appendix JA4.

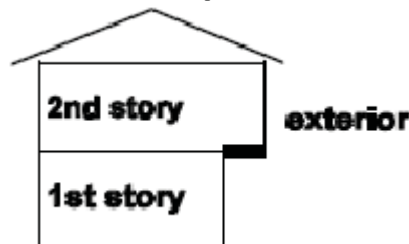
Select a U-factor that is appropriate for the basement wall construction from Tables 4.3.5 or 4.3.6, and noting any additional interior or exterior insulation. If exterior insulation is added to the foundation wall, equation 4-4 and 4-5 from Reference Appendix JA4 are used to determine the total U-factor and C-factor.

ACM Section	Task	On-Site Inspection Protocol
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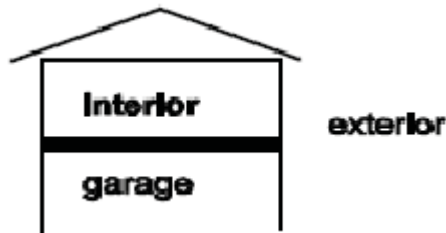
3.5.4 Raised Floors	Measure floor area over crawlspace	Measure the floor area over a crawlspace or basement to the nearest square foot.
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Measure floor area over exterior space	Measure the floor area that borders exterior unenclosed space above grade which is considered floor to exterior. For example, in a two story house, the second story may extend horizontally further than the first story, creating some floor area that is exposed to the exterior.
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Measure floor area over unconditioned garage	Measure floor area over an unconditioned garage.
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Determine floor insulation level and U-factor	For loose fill applications, multiply the thickness of the insulation (in inches) by the R-value per inch based on the insulation type in order to calculate the total existing floor insulation R-value. Also note if any exterior sheathing insulation exists. For raised floors over an unconditioned crawlspace, choose a U-factor from Table 4.4.1 of Reference Appendix JA4 based on the insulation R-value and framing thickness. For framed floors without a crawlspace, choose a U-factor from Table 4.4.2 of JA4.
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Check insulation installation quality	Insulation installation quality – determine if the insulation meets the quality installation requirements in Reference Appendix RA3, section RA3.5 or JA7 for foam installation. To qualify for the Insulation Quality Standards credit ALL insulation in ceilings, walls, and raised floors must meet the insulation quality requirements. Generally this credit cannot be taken separately for walls, ceilings, or raised floors nor for parts of walls, ceilings, or raised floors.
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3.6 Slabs-on-Grade	Identify slab on grade foundation	A slab on grade is constructed by pouring a concrete slab directly on the ground as the floor for the house.
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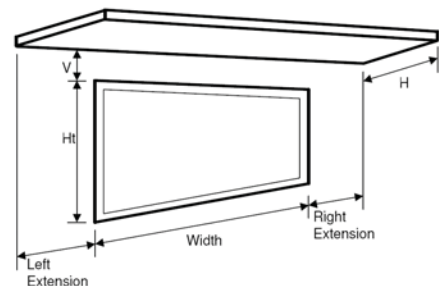


ACM Section	Task	On-Site Inspection Protocol
	Identify walkout basement	A walkout basement, if fully conditioned, is typically considered partially slab on grade construction (where the floor level is above grade) and partially a basement (where the floor level is below grade). The area of the floor that is below grade is considered to be basement floor area and the area of the floor that is on grade is considered to be slab on grade floor area. The walls over the basement portion of the floor shall be considered basement walls and the walls above the slab on grade portion shall be considered ordinary exterior walls exposed to ambient air.
	Determine perimeter of slab foundation	Determine the perimeter of the slab foundation by measuring each dimension to the nearest ½ foot and adding them together. Note that in the case above the boundary between the slab on grade portion and the basement floor portion is NOT part of the slab on grade perimeter.
	Determine perimeter and interior areas that are exposed	Determine the area near the slab perimeter (within two feet of the exterior wall) that is carpeted and the area near the slab perimeter that is exposed. Determine the area of the interior that is carpeted and the area that is exposed slab. If no measurements are taken, the default assumption is that 80% of the perimeter and interior slab areas are carpeted or covered by casework and 20% of the area is exposed.
	Determine if slab perimeter insulation exists and determine insulation depth and R-value	<p>If present, slab perimeter insulation is usually installed on the outside of the slab and extends both above and below grade.</p> <p>To identify slab perimeter insulation, look for a protective coating above grade as opposed to the usual exposed slab edge at any conditioned space(s). Determine the R-value of the insulation by multiplying the insulation thickness times the R-value per inch.</p> <p>For newly-constructed buildings, the insulation R-value that is stamped on the slab insulation may be visible. This will usually be listed as R-value per inch thickness. If the R-value is not shown, the installation contractor should provide verification of the insulation R-value. If the insulation is to be installed as part of the foundation form, the R-value should be verified prior to pouring concrete.</p> <p>If the R-value is not visible from the insulation, use 4.0 per inch for extruded polystyrene rigid boards and 6.8 per inch for rigid polyisocyanurate foam insulation (closed cell is assumed for slab edge insulation).</p> <p>For existing buildings, move a little bit of dirt away from an edge of the slab where conditioned space is located. If present, the rigid insulation around the perimeter of the slab may be seen. However, it may be difficult to visually verify the existence of slab perimeter insulation because of the protective covering which may be installed over the rigid insulation.</p> <p>Determine the slab insulation depth. Perimeter insulation should extend downwards from the top of the slab to the top of the footing, and then may extend horizontally either inwards or outwards.</p> <p>Under slab insulation cannot be assumed to exist unless visually verified by a photograph of construction, at chase way, at sump opening or at plumbing penetrations.</p>
3.7.1 Doors	Determine construction type of doors	Determine if the exterior door(s) is fiberglass, metal, or wood by making a close inspection of its texture, distinguishing the sound produced when knocking on it, and checking its side view.
	Determine orientation of doors	Measure the door orientation of each door with a compass (adjusted for magnetic deviation).
	Determine surface area of doors	Measure the surface area of the door(s) to the nearest ½ square foot. For doors with glass panes, measure the glass area including framing, and record the door opaque surface area as the total door area minus the glass area. For newly-constructed buildings, look for NFRC label values for U-factor and SHGC ratings for the entire door. If NFRC labels are not present use the values from Joint Appendix JA4, Table 4.5.1.
	Determine whether doors are insulated	<p>Determine whether the exterior door(s) is insulated (or not) by its sound, temperature transfer, labeling, or thermal break.</p> <p>Sound - Insulated/solid door will sound dull when knocked on. An uninsulated/hollow door will sound hollow.</p> <p>Heat transfer - Feel the inside and outside of the door with flat palms. Insulated/solid door will less readily transfer heat. The inside will feel warmer in cold outside weather and cooler in hot outside weather than an uninsulated/hollow door.</p> <p>Labeling - Check the side view of the door at the hinges for a descriptive label.</p>
	Determine door U-factor	Based on construction type and insulation, select a door U-factor from Table 4.5.1 of Reference Appendix JA4. For newly constructed buildings use values from NFRC labels or Table 4.5.1 of Reference Appendix JA4.
3.7.2 Fenestration Types and Areas	Determine area of windows	Measure the area of the window openings using width times height to the nearest inch. Estimate the width and height to represent the rough frame opening of the window. Typically this will be the outside dimensions of the frame plus an approximate ½ in. perimeter band.
	Determine orientation of windows	Use a compass (adjusting for magnetic deviation) to determine orientation of all windows. If a parcel map or site plan is available, orientations may be determined from the plans. Also specify the tilt of windows for windows that are not vertical.

ACM Section	Task	On-Site Inspection Protocol
	Determine window framing type	Examine each window frame in order to determine the type of material used. Open the window and examine it to see whether the frame is made of metal, wood, or vinyl. Tap the frame with fingernail or knuckle to test if it's vinyl or metal. Wood frames are usually thicker than metal.  If the window is dual-pane or multiple-pane and is metal framed, determine if a thermal break is present by looking for two separated metal extrusions connected by a non-metallic (plastic, wood, or rubber) spacer. Ask the customer for documentation if you can't tell.
	Determine window glazing characteristics	Check all windows in the house for number of panes (single, double, or glass block) and existence of tint. To determine whether the windows are single-paned or multiple-paned: <ul style="list-style-type: none"> <li>• Look at frame width and spacers;</li> <li>• Look at reflections;</li> <li>• Look at edge thickness.</li> </ul> Determine the window type: <ul style="list-style-type: none"> <li>• Operable</li> <li>• Fixed</li> <li>• Greenhouse/garden window</li> </ul> Determine if the window has dividers between the panes of double pane glass or penetrating through the glass (true divided lites). Only dividers that are outside the glazing need not be assessed.
	Determine solar heat gain coefficient of glazing	Check product information and consult NFRC guide. If NFRC product information is not available, select a representative SHGC from Table 116-B of the Title 24 Standards based on the number of panes and the existence of a tint.
	Determine window U-factor	Look for an NFRC label on new windows (it will display the U-factor of the window including the frame). If no label can be found but customer has documentation, look up product information in NFRC Certified Products Directory to determine U-factor. If the product information cannot be found in the NFRC Certified Products Directory, select the U-factor from Table 116-A of the Title 24 Standards.
	Determine area of skylights	For skylights with a curb, measure the length and width of the skylight to the outside dimensions of the curb. For skylights without a curb, estimate the dimensions of the rough frame opening.
	Determine framing and glazing characteristics of skylights	See windows.
	Determine orientation of skylights.	Determine the orientation of the lower edge of the skylight. Use the outward horizontal direction perpendicular to the lower edge of the skylight as the orientation of the skylight.
	Determine tilt of skylights	Measure the tilt of the skylight relative to horizontal. This can be done with a level and angle finder instrument or geometrically with a protractor or assume the same tilt as the pitch of the roof where the skylight is installed.
	Determine skylight U-factor	See windows
	Determine solar heat gain coefficient of skylights	See windows

### 3.7.3 Overhangs and Sidesfins

Determine overhang dimensions	<ul style="list-style-type: none"> <li>• Window height (H) – the height of the window</li> <li>• Window width – the width of the window</li> <li>• Distance above window (V) – the vertical distance between the top of the window and the bottom edge of the overhang</li> <li>• Right extension – the horizontal distance between the right edge of the window and the edge of the overhang</li> <li>• Left extension – the horizontal distance between the left edge of the window and the edge of the overhang</li> </ul>
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ACM Section	Task	On-Site Inspection Protocol
	Determine sidefin dimensions (including walls at right angles to the window)	<ul style="list-style-type: none"> <li>Window height (Ht)– the height of the window</li> <li>Distance from fenestration – the distance from the edge of the window to the sidefin or sidewall</li> <li>Fin height (Fin Ht) – the vertical height of the sidefin or sidewall</li> <li>Fin projection (H)– the horizontal projection of the fin or sidewall out from the wall in which the window is installed</li> <li>Distance from window top to fin or sidewall top (V)</li> </ul>
	Determine external shading device type	Identify the type of exterior shading device from Table R3-28 of the Residential ACM Manual (standard bug screens, woven sunscreens, louvered sunscreens, low sun angle louvered sunscreens, roll-down awnings, or roll-down blinds or slats). The most common screen is an insect screen that covers some or all of the window. If it is a full-coverage type screen and has a dense weave, assume it is a shade screen.
3.9.1 System Type		Determine the System Type for heating and for cooling from the list below:
3.9.2 Multiple System Types	Determine the floor area served by each system.	If a central system serves the area (supply registers) then the central system type should be used. Otherwise estimate the area served by each system.
3.9.3 Multiple System Types Serving the Same Area		If an area is served by more than one heating system or more than one cooling system, note the system types and the area (room or rooms) that they serve.
3.9.4 No Cooling	Determine if the rated home has air conditioning	Note the areas of the house that have no air-conditioning or evaporative cooling.
3.10.1 Heating System Type	Determine fuels used for heating and cooling	<p>Heating systems may use natural gas, propane, oil, or electricity.</p> <ul style="list-style-type: none"> <li>Oil - look for a large storage tank (typically oblong-shaped) or fill pipes which would indicate a buried tank. Oil is typically supplied to the heating equipment via a 1/4" - 3/8" copper line. A fuel filter may be evident in the line.</li> <li>Natural gas - look for a meter connected to piping on the exterior of the home. Piping to the heating equipment is typically done with 1/2" - 1" iron piping.</li> <li>Propane - look for storage tank(s) (typically cylindrical-shaped). Large tanks may be buried with a 12" - 18" cap exposed above grade. Fuel is typically supplied to equipment through 1/4" - 3/8" diameter copper piping.</li> <li>Electric - look for large gauge cables running to a central piece of equipment or look at circuit breaker panel for circuits marked for resistance heat circuits (electric resistance or electric radiant systems).</li> </ul>

ACM Section	Task	On-Site Inspection Protocol
	Identify type(s) of equipment for heating	<p>For heating systems, choose from one of the following:</p> <ul style="list-style-type: none"> <li>• CntrlFurnace - comprised of a combustion chamber and heat exchanger (natural gas, propane or oil) or an electric resistance element (electric) and a fan which forces air across the heat exchanger or resistance element to provide heat in a forced air system. Gas fan-type central furnaces have a minimum AFUE=78%.</li> <li>• Boiler - Gas or oil boilers. Distribution systems can be Radiant, Baseboard or any of the ducted systems. Boiler may be specified for dedicated hydronic systems.</li> <li>• Heater - Non-central gas- or oil-fired space heaters, such as wall heaters floor heaters or unit heater. Equipment has varying efficiency requirements. Distribution is ductless and may be gravity flow or fan-forced..</li> <li>• SplitHeatPump - Split system central air source heat pump. These systems move energy from one location to another using the vapor compression cycle. They are electrically driven, and can provide heating in winter and cooling in summer by reversing the direction of heat flow. Split system heat pumps consist of an outdoor unit and an indoor air handling unit, resembling a furnace. These systems require ductwork for air distribution. This descriptor is for both the heating and cooling system.</li> <li>• PkgHeatPump - Single package central air source heat pump. A single package central heat pump is similar to a split system, except it combines the functions of the indoor and outdoor units into one cabinet, usually mounted on the roof or on the ground. It also requires a separate distribution system. These are sometimes found in multi-family dwellings. This descriptor is for both the heating and cooling system.</li> <li>• LrgPkgHeatPump –large packaged units rated at or above 65,000 Btu/hr (heating mode). Distribution system shall be one of the ducted systems. These include water source and ground source heat pumps.</li> <li>• RoomHeatPump - non-central room air conditioning systems. These include small ductless split system heat pump units and packaged terminal (commonly called “through-the-wall”) units. This descriptor is for both the heating system and cooling system.</li> <li>• Non-ducted Electric - All electric heating systems other than space conditioning heat pumps. Included are electric resistance heaters (convective or radiant), electric boilers and storage water heat pumps (air-water) (StoHP). Distribution system can be Radiant, Baseboard or any of the ducted systems.</li> <li>• CombHydro - Water heating system can be storage gas (StoGas, LgStoGas), storage electric (StoElec) or heat pump water heaters (StoHP). Distribution systems can be Radiant, Baseboard, or any of the ducted systems and can be used with any of the terminal units (FanCoil, RadiantFlr, Baseboard, and FanConv).</li> </ul>
	Determine the location of the distribution system for heating	Identify the location of the distribution system for heating. Common choices are attic, basement, garage or ventilated closet.
	Identify the control system for the heating	Determine the type of control systems. There may be separate controls for the heating and cooling systems. Thermostat controls may be programmable.
	Determine heating system efficiency	<p>Identify the model number from the nameplate and review CEC appliance directories or historical GAMA product directories to determine the efficiency. If the efficiency cannot be found, use the default value from Table R3-50 of the Residential ACM Manual based on the estimated age of the equipment.</p> <ul style="list-style-type: none"> <li>• AFUE is used to measure the efficiency of furnaces and boilers.</li> <li>• HSPF is used to measure the heating performance of heat pumps. If a HSPF rating is not available, look for a COP rating and use Equation R3-32 in the Residential ACM Manual to convert to HSPF.</li> </ul>

ACM Section	Task	On-Site Inspection Protocol
3.11.1 Cooling System Type	Determine the type of cooling system.  Identify the control system for the heating and cooling system(s)	For cooling systems, choose from one of the following systems listed in Table R3-33: <ul style="list-style-type: none"> <li>No Cooling - Entered when the proposed building is not air conditioned.</li> <li>SplitAirCond - Split system air conditioner, - similar to a split system air source heat pump. Consists of an outdoor unit and a coil in the forced air distribution system, usually in a fossil fuel furnace.</li> <li>PkgAirCond - Central packaged air conditioning systems less than 65,000 Btuh cooling capacity.</li> <li>LrgPkgAirCond - Large packaged air conditioning systems rated at or above 65,000 Btu/hr (cooling capacity).</li> <li>RoomAirCond - Non-central room air conditioning cooling systems. These include small ductless split-system air conditioning units and packaged terminal (commonly called through-the-wall) air conditioning units.</li> <li>SplitHeatPump - Split system central air source heat pump.</li> <li>PkgHeatPump - Single package central air source heat pump.</li> <li>LrgPkgHeatPump - large packaged units rated at or above 65,000 Btu/hr (heating mode).</li> <li>RoomHeatPump - non-central room air conditioning systems.</li> <li>GasCooling - gas absorption cooling. Look for a cooling tower, an exhaust pipe, a gas burner to evaporate refrigerant and a heat exchanger similar to an electric air conditioner.</li> <li>EvapDirect - Direct evaporative cooler. Evaporative coolers work by blowing air over a damp pad or by spraying a fine mist of water into the air.</li> <li>EvapIndirect - Indirect evaporative cooler - evaporation takes place on only one side of a heat exchanger so that additional moisture is not added to the cooled air.</li> <li>EvapIndirDirect - Indirect-direct evaporative cooler.</li> <li>Evap/CC - Evaporatively Cooled Condensers. A split mechanical system, with a water-cooled condenser coil.</li> <li>IceSAC - Ice Storage Air Conditioning. Split air conditioner condensing coil in combination with ice storage.</li> </ul> Determine the type of control systems. There may be separate controls for the heating and cooling systems. Thermostat controls may be programmable.
3.11.3 Refrigerant Charge or Charge Indicator Light	Verify refrigerant charge or Charge Indicator Light	To take a credit for proper refrigerant charge, verify refrigerant charge according to the procedures in Reference Appendix RA3, section 3.2. The air handler airflow must also be verified for this test see section 3.3 of RA3). If a charge indicator light is present, verify its functionality by the procedure in Reference Appendix RA3, section 3.2.2.  The refrigerant charge test applies to split system air conditioners and heat pumps.
3.11.4 Maximum Cooling Capacity Credit	Maximum Cooling Capacity Credit	Credit is available for new systems if the installed cooling capacity is less than or equal to the cooling capacity determined by sizing procedures in Reference Appendix RA1. The system must have verified cooling coil airflow and sealed and tested ducts to claim this credit.
3.11.5 Adequate Airflow	Verify Airflow over Central Cooling Coil	To receive credit for adequate airflow, follow the procedures in Reference Appendix RA3, section 3.3. If the airflow is not measured by the rater, a default value shall be assumed.
3.11.6 Fan Energy	Verify fan Watt draw	To receive credit for verified fan Watt draw, follow the procedures in Reference Appendix RA3, section 3.3. Airflow must be measured simultaneously to obtain a Watt draw in Watt/cfm. If no measurement is taken, a fan Watt draw of 0.8 W/cfm is assumed.

ACM Section	Task	On-Site Inspection Protocol
3.11.7 Cooling System Calculations	Determine the cooling equipment efficiency	<p>Check nameplate for the model number and use this number to determine the efficiency from CEC appliance directories or ARI directories. If the efficiency cannot be determined, use the default value from Table R3-50 of the Residential ACM Manual based on the estimated age of the equipment.</p> <ul style="list-style-type: none"> <li>SEER is used to measure the seasonal efficiency of central air conditioners and air source heat pumps that have single phase power and a capacity of 65,000 Btuh or less. Credit is also available for high EER central air conditioners and air source heat pumps that have SEER ratings. To verify high EER efficiency ratings use the procedures in Reference Appendix RA3, Section 3.4.</li> <li>EER is used to determine the efficiency of electric air conditioners and air conditioners older than 1988.</li> <li>For indirect and indirect-direct evaporative cooling units an SEER and EER of 13 is assumed for energy calculations, For direct systems a fixed SEER of 13 is assumed. Since efficiencies for evaporative cooling systems are assumed, only the system type needs to be identified.</li> <li>For evaporatively cooled condensing units, EER at 75 degrees wet-bulb and at 65 degrees wet-bulb is used. The eligibility requirements of Reference Appendix RA4, Section 4.3.2 shall be met.</li> <li>For gas absorption cooling three descriptors, COP95, the rated COP for the gas portion, CAP95, the rated capacity, and PPC, the parasitic electric energy at rated conditions in Watts shall be determined.</li> <li>For ice storage air conditioning systems, eligibility requirements of Reference Appendix RA4, Section 4.3.1 shall be met. The model number from the nameplate must be determined.</li> </ul>
3.12 Air Distribution	Identify type of distribution system used to provide space heating and cooling	Determine how the HVAC system distributes heating or cooling to the interior of the home. The most common types of distribution systems use air or water to distribute heating or cooling through ducts or pipes. Some systems rely on natural means to distribute heating or cooling without pipes or ducts..
	Air Distribution Systems	<p>Determine if an air distribution system is used. Fan-powered, ducted distribution systems are used with most heating or cooling systems. When ducted systems are used with furnaces, boilers, or combined hydronic/water heating systems the electricity used by the fan shall be calculated using the methods described later in this manual. R-value shall be specified in "Duct R-value" column when a ducted system is specified</p> <p>DuctsAttic Determine if the ducts are located overhead in the unconditioned attic space</p> <p>DuctsCrawl Determine if the ducts are located underfloor in the unconditioned crawl space</p> <p>DuctsCVC Determine if the ducts are located underfloor in a controlled ventilation crawl space</p> <p>DuctsGarage Determine if the ducts are located in an unconditioned garage space.</p> <p>DuctsBasemt Determine if the ducts are located in an unconditioned basement space</p> <p>DuctsInEx12 Determine if the ducts located within the conditioned floor space except for less than 12 lineal feet of duct, typically an HVAC unit in the garage mounted on return box with all other ducts in conditioned space.</p> <p>DuctsInAll Determine if the HVAC unit or systems and all HVAC ducts are located within the conditioned floor space. Location of ducts in conditioned space eliminates conduction losses but does not change losses due to leakage. Leakage from either ducts that are not tested for leakage or from sealed ducts that are modeled as leakage to outside the conditioned space.</p> <p>DuctsOutdoor Determine if the ducts are located in exposed locations outdoors.</p> <p>DuctsNone Determine if the air distribution systems has no ducts such as ductless split system air conditioners and heat pumps, window air conditioners, through-the-wall heat pumps, etc.</p>
	Ductless Systems	<p>Ductless radiant or warm/cold air systems using fan-forced or natural air convection and hydronic systems relying upon circulation pumps and fan-forced or natural air convection and</p> <p>Furnaces Determine if heating equipment such as wall and floor furnaces are present and used</p> <p>Radiant Determine if radiant electric panels or fanless systems are used with a boiler, electric or heat pump water heater, or combined hydronic heating equipment.</p> <p>Baseboard Determine if electric baseboards or hydronic baseboard finned-tube natural convection systems are present and used</p>
	Special Credits for Air Distribution Systems	<p>LowLJCod Verified Low Leakage Ducts in Conditioned Space – To claim credit for this measure, a rater shall diagnostically test the ducts to verify that air leakage to outside conditions is equal to or less than 25 cfm when measured in accordance with Section RA4-4.3.3, steps 1 through 9.</p> <p>LowLkAH Low Leakage Air Handlers – Determine if the model number of the air handling unit is one that is a factory sealed air handler unit that has been tested by the manufacturer and certified to the Commission to have achieved a 2 percent or less leakage rate at 1-inch water gage – as prescribed in RA4-4.3.9.</p>

ACM Section	Task	On-Site Inspection Protocol
3.12.3 Special Credits (Duct Location and Area)	Determine the location of ducts	Air ducts may be located in the attic, crawl space, a controlled ventilated crawlspace, unconditioned area (basement or garage) or in a conditioned area. You must locate and differentiate between supply and return ducts. Ducts may be located in more than one area (for example, some return ducts in attic and some in conditioned space). See Table R3-34 of the Residential ACM Manual for a list of duct locations.
	Determine the surface area of ducts in unconditioned space	<p>A credit is available for duct systems for HVAC systems with air handlers located outside the conditioned space but with less than 12 lineal feet of duct located outside the conditioned space (including air handler and plenum). This is an alternative to recording the surface areas of individual duct segments in the unconditioned space.</p> <p>If this does not apply, then the duct lengths and inside dimensions must be measured to determine duct surface area. The inside surface dimensions of duct segments in unconditioned spaces (attic, crawlspace, basement or other) and the duct segment lengths are taken to determine duct surface areas. This measurement is required if the credit for verified low leakage ducts is taken. The area of ducts in the conditioned space is not included. The area of ducts in floor cavities or vertical chases that are surrounded by conditioned space and separated from unconditioned space with draft stops are also not included.</p> <p>If no measurement is taken a default surface area is assumed.</p>
	Determine presence of attic radiant barrier	See 3.4.4.
3.12.4 Duct System Insulation	Determine the value of distribution system insulation	<p>Air ducts may be insulated with insulation blankets or rigid insulation board. Inspect the duct or pipe insulation for R-value labeling (printed on the insulation by the manufacturer). If the insulation is not marked with the R-value, identify type and measure the thickness of the insulation to determine R-value. Check for internal insulation by tapping on the exterior and listening to the sound.</p> <p>For ducts buried in attic insulation, effective insulation R-values shall be taken from Table R3-38 of the Residential ACM Manual. The portions of duct runs directly on or within 3.5 inches of the ceiling gypsum board and surrounded with blown attic insulation of R-30 or greater may take credit for increased effective duct insulation as shown in Table R3-38.</p> <p>Credit shall be allowed for buried ducts on the ceiling only in areas where the ceiling is level and there is at least 6 inches of space between the outer jacket of the installed duct and the roof sheathing above.</p> <p>Deeply buried ducts may take credit for an effective R-25 for fiberglass and R-31 for cellulose insulation when Residential ACM requirements are met.</p>
	Determine presence of ducts buried in attic insulation	Ducts partly or completely buried in blown attic insulation in dwelling units meeting the requirements for High Insulation Quality (Residential Appendix RA3-2008, section 3.5) and Procedures for Field Verification and Diagnostic Testing of Air Distribution Systems (Residential Appendix RA3-2008, section 3.1) may take credit for increased effective duct insulation. For each duct segment buried in attic insulation, indicate the duct diameter, attic insulation value and insulation type (fiberglass or cellulose).
3.12.5 Duct/Air Handler Leakage	Determine air leakage from ducts	<p>Follow the test procedures in section 3.1 of Reference Appendix RA3.</p> <ol style="list-style-type: none"> <li>Duct Leakage for new ducts – air leakage in ducts is tested according to procedures in RA3.1.4.3 of Reference Appendix RA3. The duct leakage factors for sealed and tested new duct systems correspond to sealed duct requirements in newly constructed dwelling units, to entirely new duct systems in existing dwelling units, and to duct systems in alterations and additions that have been sealed to meet the duct leakage requirements of procedures in RA3, section 3.3.</li> <li>Duct Leakage for existing ducts – air leakage for existing ducts is tested according to procedures in section 3.1 of Reference Appendix RA3. The duct leakage factors for sealed and tested duct systems in existing dwelling units apply only to sealed duct requirements for alterations to existing dwelling units and to extensions of existing duct systems to serve additions. The total fan system airflow must also be measured according to procedures in RA3, section 3.3.</li> <li>Verified Low leakage ducts in Conditioned space – this credit is available for ducts entirely in conditioned space that have been tested to have an air leakage to the outside less than 25 cfm according to the test procedures in RA3, section 3.1.4.3.</li> <li>Sealed Existing Duct Systems – the objective of this test is to show a 60% reduction in leakage rate after sealing all the ducts. Existing duct systems that fail to pass the duct leakage tests may be tested after sealing all accessible leaks. A smoke test must then be performed according to procedure RA3.1.4.3.5 or RA3.1.4.3.6 of Reference Appendix RA3 to visually verify duct leakage improvement.</li> </ol> <p>If no duct leakage testing is performed a default leakage is assumed.</p>
	Determine if low leakage air handler is present	A verified low leakage air handler credit is available for an air handler cabinet that has been certified to leak no more than 2 percent of its nominal airflow when pressurized to 1" w.g. Look for an indication of air leakage testing on the air handler label. To obtain this credit, ducts must be sealed and tested according to the procedures in Reference Appendix RA3.

ACM Section	Task	On-Site Inspection Protocol
3.13 Mechanical Ventilation	Measure fan Watt draw for mechanical ventilation systems	<p>There are two ways of providing mechanical ventilation to provide IAQ: a standalone IAQ fan system and a central air handler fan system that can introduce outdoor air.</p> <p>A standalone indoor air quality fan system is a fan system (one or more ventilation fans) that provide at least the system airflow (Qfan) given by</p> $Q_{fan} = 0.01A_{floor} + 7.5(N_{br} + 1)$ <p>where Nbr is the number of bedrooms and Afloor is the conditioned floor area.</p> <p>For a standalone indoor air quality (IAQ) fan system is installed, determine the following data:</p> <ol style="list-style-type: none"> <li>1. Fan W/cfm at expected operating conditions. Measure the fan Watt draw and airflow simultaneously and record the ratio as a decimal fraction. Use an exhaust fan flow meter to measure the CFM and a true power watt meter to measure the fan watts.</li> <li>2. The fan system type shall be noted as "Unbalanced" for an exhaust or supply only system or "Balanced" for a system with both a supply and return fan.</li> <li>3. If the stand alone ventilation system provides heat recovery, the sensible heat recovery effectiveness as a decimal fraction shall be obtained from product information.</li> </ol> <p>For Central Air handlers, the air handler airflow and fan Watt draw shall be measured according to procedures in Residential Appendix RA3-2008, section 3.3. A default value of 0.8 W/cfm is used if the airflow and fan Watt draw are not measured. Also determine whether or not the system:</p> <ol style="list-style-type: none"> <li>1. directly introduces outdoor air into the central system ducts or</li> <li>2. uses a central fan integrated ventilation system to automatically mix outdoor air provided by a separate ventilation fan not directly connected to the central system ductwork. A central fan integrated ventilation system automatically provides this mixing when the HVAC system is not already operating to provide heating or cooling.</li> </ol>
3.15 Water Heating	Determine type and heat source of water heater	<p><b>Storage.</b> These water heaters are the most common type. Water is heated in an insulated tank that typically ranges in capacity from 30 to 75 gallons. Storage water heaters may use electric resistance, gas, propane, oil or electric heat pump.</p> <ul style="list-style-type: none"> <li>• Storage electric -look for rigid or flexible 240 A/C conduit, UL seal, no vent, no burner or pilot tubing. Thermostats are usually hidden behind metal access doors. Often there is both an upper and a lower thermostat.</li> <li>• Storage gas -look for a vent connection (top of tank), gas connector and line valve, thermostat, burner and pilot tubing, burner compartment doors, and "AGA" seal rating plate. Most gas water heaters have legs to lift the unit above the floor level to provide combustion air to the burner.</li> <li>• Storage propane -look for the same features as those listed for gas water heaters. Also, look for a rating plate or tag that states "For Use with LP Gas Only."</li> <li>• Large Storage gas – a storage gas heater with an input capacity greater than 75,000 Btu/hr.</li> <li>• Storage heat pump -water heaters remove heat from the air in the room where they are located and then release the heat to the water in the storage tank. Look for the same features as those found on electric water heating systems. In addition, there will be a fan, condenser and evaporator. Also, the system may be one single unit, or may be a split system.</li> <li>• Indirect Storage Gas – storage tank indirectly heated by gas or oil-fired source. In addition, oil systems are usually furnished with draft regulators which are attached to the vent pipe between the tank and chimney. Vent dampers may also be apparent on the vent pipe.</li> <li>• Boiler – boiler dedicated solely to hydronic space heating</li> <li>• Combination DHW/furnace system (CombHydro heating system) - natural gas combo systems use heat drawn from a hot water tank circulating through an air handling module to heat the space.</li> </ul> <p><b>Instantaneous.</b> These water heaters heat water on demand, instead of storing pre-heated water in a large tank. They are usually small units, with storage of no more than 2 gallons, and are often attached to a wall close to the point of use. Instantaneous water heaters may be used in addition to a primary storage water heater to serve fixtures in a distant location of the house, so check for a main storage unit as well. Determine if the instantaneous heater uses gas or electricity. The CEC Appliance Efficiency Regulations define an instantaneous water heater as "a water heater that has an input rating of at least 4,000 Btu per hour per gallon of stored water."</p> <ul style="list-style-type: none"> <li>• Instantaneous gas - look for a connector and line valve, vent connection, thermostat, burner and pilot tubing, and AGA seal. Check whether unit has a pilot light or intermittent ignition device.</li> <li>• Instantaneous electric - look for the absence of a gas line, vent or pilot light. Look for a UL seal.</li> </ul> <p>Super-heater - check for this supplementary heat source.</p>
	Determine location of storage tank	Determine whether water heater is located in conditioned or unconditioned space.

ACM Section	Task	On-Site Inspection Protocol
	Determine the capacity of the storage tank	Determine the size of the storage tank by referring to manufacturer's literature, the FTC label for new storage water heaters, or by using the model number and manufacturer's information.
	Determine the Energy Factor or Seasonal Efficiency of the water heater	<p>Storage Water Heaters</p> <p>Determine the EF by examining the water heater's nameplate and product literature. Some water heaters will list their EF right on the nameplate. If the EF cannot be determined in this manner use the model number to find the EF from CEC appliance directories or manufacturer trade association directories.</p> <p>If the EF cannot be determined from the FTC label or from the model number and manufacturer's information use the equations below to determine the EF.</p> <p>Gas Water Heaters                      <math>EF = 0.62 - (0.0019 \times V)</math></p> <p>Electric Water Heaters                  <math>EF = 0.93 - (0.00132 \times V)</math></p> <p>Where V is the volume of the water heater in gallons.</p> <p>For older water heaters (manufactured before 2004), which are wrapped with R-12 insulation or better, add 0.05 to the EF.</p> <p>For large storage gas water heaters not covered by NAECA (greater than 75,000 Btu/hr input), look for an efficiency rating on the water heater, and the Tank R-value (hr-ft<sup>2</sup>-F/Btu), the total thermal resistance of the internally-insulated tank and the R-value of any external insulation wrap. The standby loss is taken from the Energy Commission database.</p> <p>Combined Hydronic Heating Systems</p> <p>For combined hydronic heating systems, determine the heat input in kBtu/h for gas (or kW for electric) and the recovery efficiency (%). For large storage gas or indirect gas water heaters in a combined hydronic heating system, determine the pump input in Watts.</p> <p>Instantaneous Water Heaters</p> <p>For large instantaneous water heaters (&gt;10 gal storage), determine the unit's TE (Thermal Efficiency) from the nameplate or by using the model number and CEC or manufacturer's directories. For gas models, determine if there is a standing pilot light. Determine the pilot light energy consumption (Btu/hr) from the Energy Commission's database. Also record the standby loss in Btu/h and note the R-value of any external insulation wrap.</p> <p>For small instantaneous water heaters, determine the EF of the water heater.</p>
	Determine type of distribution system	Determine if a point of use water heating system or a recirculation system is installed. To claim credit for a point of use system, all fixtures shall be within 8 feet of a water heater, as specified in Reference Appendix RA4. For single dwelling units with recirculation systems, determine the recirculation control type from Table R3-45 of the Residential ACM Manual.
	Determine the water distribution piping location and insulation	Determine if the water pipes are in the attic, a crawlspace, or under the slab. If they are under the slab, determine if they are insulated. If there is no documented evidence of pipe insulation under the slab assume that the pipes are uninsulated.
	Determine recirculation control for multiple dwelling units	If the system serves multiple dwelling units, determine the recirculation control type from Table R3-46 of the Residential ACM Manual.
	Determine pump motor size and efficiency for recirculating systems	Determine the pump motor size and efficiency rating from nameplate information or manufacturer's information.
	Recirculating system dwelling unit information	Determine the number of apartments and the number of stories served by the recirculation system.
	Recirculating system pipe location, length, and insulation thickness	Determine fraction of piping between dwelling units that is located (a) outdoors, (b) in conditioned or semi-conditioned space, (c) buried in ground. For each pipe segment, measure its length, note its location and indicate pipe insulation thickness in inches. Indicate the total lineal feet of all circulation piping.

ACM Section	Task	On-Site Inspection Protocol
Determine type of solar systems		<p>Determine whether a solar domestic hot water system exists. These systems collect and store solar thermal energy for domestic water heating applications. If a solar water heating system exists, determine system type. Identify as passive or active. Base your evaluation on these criteria:</p> <ul style="list-style-type: none"> <li>• Passive - No purchased electrical energy is required for recirculating water through a passive solar collector. Three types of passive systems are integrated collector storage (ICS), thermosiphon systems and self-pumped systems.</li> <li>• Integrated Collector Storage (ICS) - consists of a single unit which incorporates both collector and water storage. An example is the common "bread box" design. Storage is usually outside the conditioned space.</li> <li>• Thermosiphon - consists of a flat-plate solar collector and hot water storage tank. Instead of using a pump, circulation of the fluid is achieved by natural convection action. The storage tank must be located above the collector, and is usually outside the conditioned space.</li> <li>• Self-pumped - circulates fluid from storage to collectors without purchased electrical energy. Photovoltaic and percolating systems are examples of self-pumped systems. The storage tank is usually inside the conditioned space.</li> <li>• Active -Also known as pumped systems.</li> <li>• Pumped -purchased electrical energy input is required for operation of pumps or other components. The storage tank is usually inside the conditioned space.</li> </ul> <p>Determine the type of solar collector by checking for the SRCC label or manufacturer's information.  Determine the parameters for solar performance from the OG-100 or OG-300 test procedures based upon information from the homeowner or from the model number, manufacturer's information, and SRCC directories.</p>
Determine efficiency of solar system		<p>Look for SRCC label. Check for SRCC system and component name plates. Refer to the Directory of SRCC Certified Solar Collector and Water Heating System Ratings, or other SRCC literature for solar energy factor (SEF) and other performance data. For systems manufactured after Jan. 1, 1995, system type, solar energy factor (SEF), and other performance characteristics shall be determined from the SRCC label (usually affixed to the solar storage tank) and by referring to SRCC literature. For systems lacking an SRCC label, energy factor and other performance characteristics can be determined using a certified HERS modeling tool, or appropriate default values.</p>

HTM Section	Task	On Site Inspection Protocols
<b>4.5 Appliances and Miscellaneous Energy Use</b>		
<b>4.5.1 Refrigerator/Freezer</b>	Determine the number, location, and energy consumption of refrigerators and freezers	Determine the approximate size (ft <sup>3</sup> ) and basic type of the primary refrigerator. Basic types are freezer inside, freezer above, freezer below, side-by-side, through the door water service, and through the door ice service. Determine if there are other refrigerators or independent freezers in the house, garage, or outside and note the location, particularly if they are or are not in conditioned space.
<b>4.5.2 Dishwasher</b>	Determine the presence or absence of dishwasher and efficiency	Determine if a dishwasher is present. If present, determine the energy factor for the dishwasher.
<b>4.5.3 Clothes Dryer</b>	Determine the presence and type of clothes dryer	Determine if there is a clothes dryer or hookup for a clothes dryer. If a dryer or hookup is present determine its type (gas or electric) and whether or not it is located in conditioned space. Determine if it is a gas dryer or an electric dryer.
<b>4.5.4 Clothes Washer</b>	Determine the presence and type of clothes washer	Determine if there is a clothes washer or hookups for a clothes washer. If one is present determine its type (gas or electric) and its location, particularly if it located in conditioned space or not.
<b>4.5.5 Oven/Range</b>	Determine the presence and type of oven/range	Determine if there is a range with a cooktop with or without an associated non-microwave oven. If one is present determine its type (gas or electric) and whether or not there are continuously burning pilot lights for the range cooktop or the oven if they are gas appliances. Note that a gas range cooktop with intermittent ignition devices (IIDs) and no continuously burning pilot lights should produce the characteristic electric sparking sound when first turning on one of the range burners. A continuously burning pilot light on the other hand will often produce one or more warm spots on the non burner portion of the cooktop.
<b>4.5.6 Miscellaneous Electricity</b>	Determine the presence or absence of other appliances	Determine the presence and number of any of the appliances or energy-consuming products listed in Appendix B of this manual.
<b>4.6 Lighting</b>		
	Determine the energy used for lighting inside and outside the home	
<b>4.6.1 Interior Lighting</b>	Determine the number and type of fixtures inside the home	Using the rules specified in Tables 6 and 7 of Section 4.6.1 of this manual, determine the number and type of luminaires that are inside the conditioned part of the house.
<b>4.6.2 Outdoor Lighting</b>	Determine the number and type of lighting fixtures attached to the outside of the home	Using the rules specified in Tables 6 and 7 of Section 4.6.1 of this manual, determine the number and type of luminaires that are attached to the outside of the house, garage, or any other ancillary buildings on the lot.
	Determine the number and type of lighting fixtures inside the garage and other buildings on the same lot.	Using the rules specified in Tables 6 and 7 of Section 4.6.1 of this manual, determine the number and type of luminaires that are inside of the garage (attached or detached) and on the inside of other buildings detached from the home but on the same lot.