# Builder Energy Code Training

*Presented by:*

## The Building Industry Institute

and

## ConSol

*Sponsored by:*

STATE OF CALIFORNIA
ENERGY COMMISSION

the BUILDING INDUSTRY INSTITUTE

DEPARTMENT OF ENERGY
UNITED STATES OF AMERICA

# Builder Energy Code Training 2002

Purpose:

a) Increase Quality of Homes
b) Reduce Defect Litigation
c) Enlighten about Energy Standards
d) Provide Energy Efficient Homes

Implementation:

a) Installation Techniques
b) Scope of Work Revisions
c) Third Party Inspections
d) On-Site Instruction

# Benefits for Energy Conservation

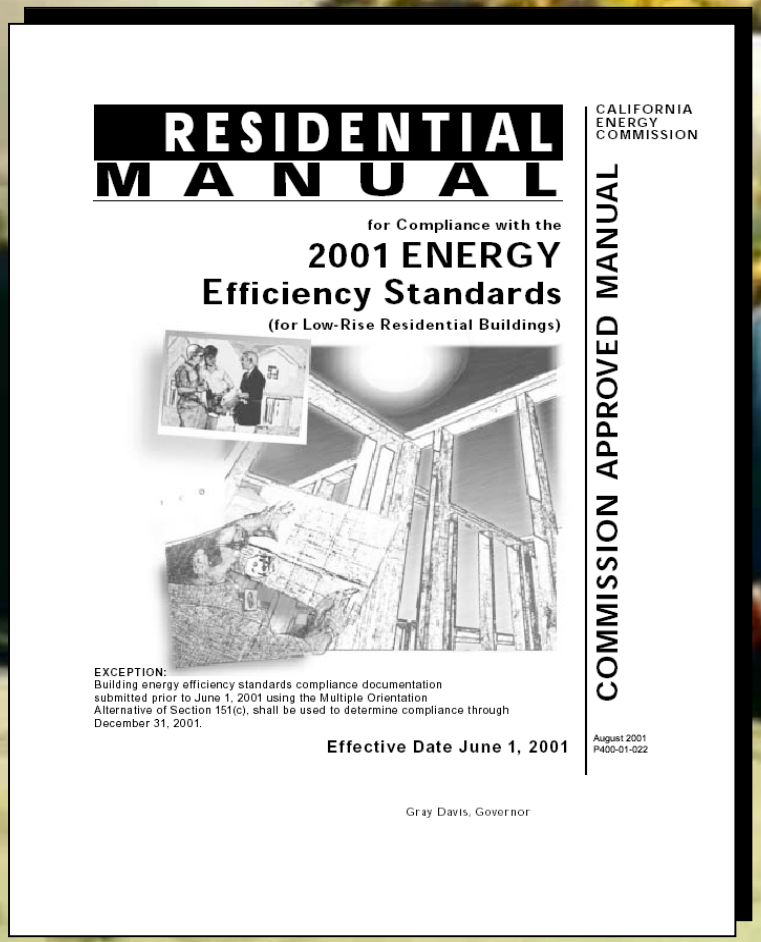
(New Residential Construction)

- Energy Reliability
- Energy Demand Reduction
  - 100,000 MWh Peak Reduction
- Comfort
- Economics
- Environment

# 2001 T24 Changes

- 12% Increase in Stringency of Title 24

| Climate Zone | Glazing | | Roof | Duct Seal | A/C Coil | % Change |
|---|---|---|---|---|---|---|
| | U-value | SHGC | | | | |
| 1 | | | | Sealed | | 5% |
| 2 | | 0.40 | RB | Sealed | TXV | 11% |
| 3 | | | | Sealed | | 4% |
| 4 | | 0.40 | RB | Sealed | | 12% |
| 5 | | | | Sealed | | 4% |
| 6 | | | | Sealed | | 3% |
| 7 | | 0.40 | | Sealed | | 11% |
| 8 | | 0.40 | RB | Sealed | TXV | 14% |
| 9 | | 0.40 | RB | Sealed | TXV | 18% |
| 10 | 0.65 | 0.40 | RB | Sealed | TXV | 20% |
| 11 | | 0.40 | RB | Sealed | TXV | 14% |
| 12 | | 0.40 | RB | Sealed | TXV | 11% |
| 13 | | 0.40 | RB | Sealed | TXV | 16% |
| 14 | | 0.40 | RB | Sealed | TXV | 15% |
| 15 | | 0.40 | RB | Sealed | TXV | 23% |
| 16 | | | | Sealed | | 8% |
| | | | | | Average | 12% |



RESIDENTIAL MANUAL

for Compliance with the

2001 ENERGY Efficiency Standards

(for Low-Rise Residential Buildings)

EXCEPTION:
Building energy efficiency standards compliance documentation submitted prior to June 1, 2001 using the Multiple Orientation Alternative of Section 151(c), shall be used to determine compliance through December 31, 2001.

Effective Date June 1, 2001

CALIFORNIA ENERGY COMMISSION

COMMISSION APPROVED MANUAL

August 2001
P400-01-022

Gray Davis, Governor

# Title 24

- Climate Zones
- Mandatory Measures
- Methods of Compliance
- Energy Budgets
- Energy Features
- Documentation

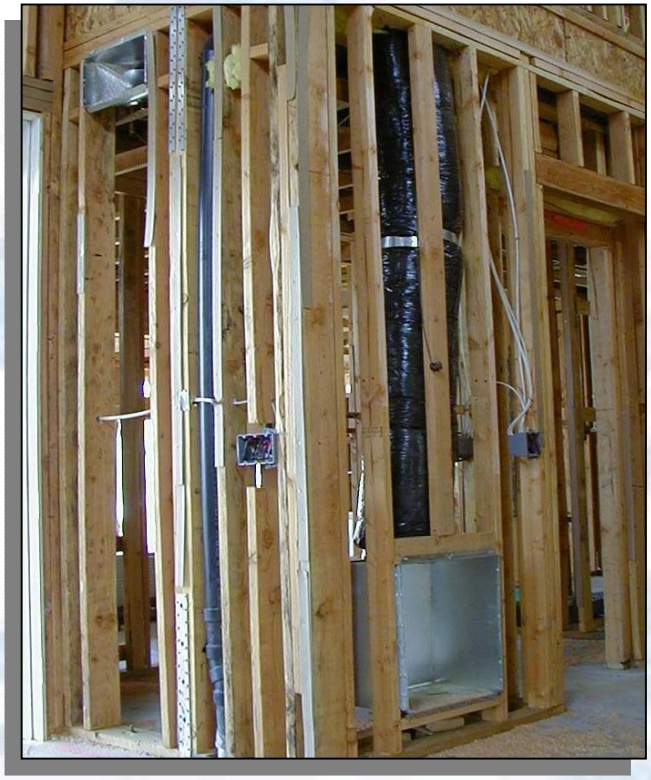
# Mandatory Measures

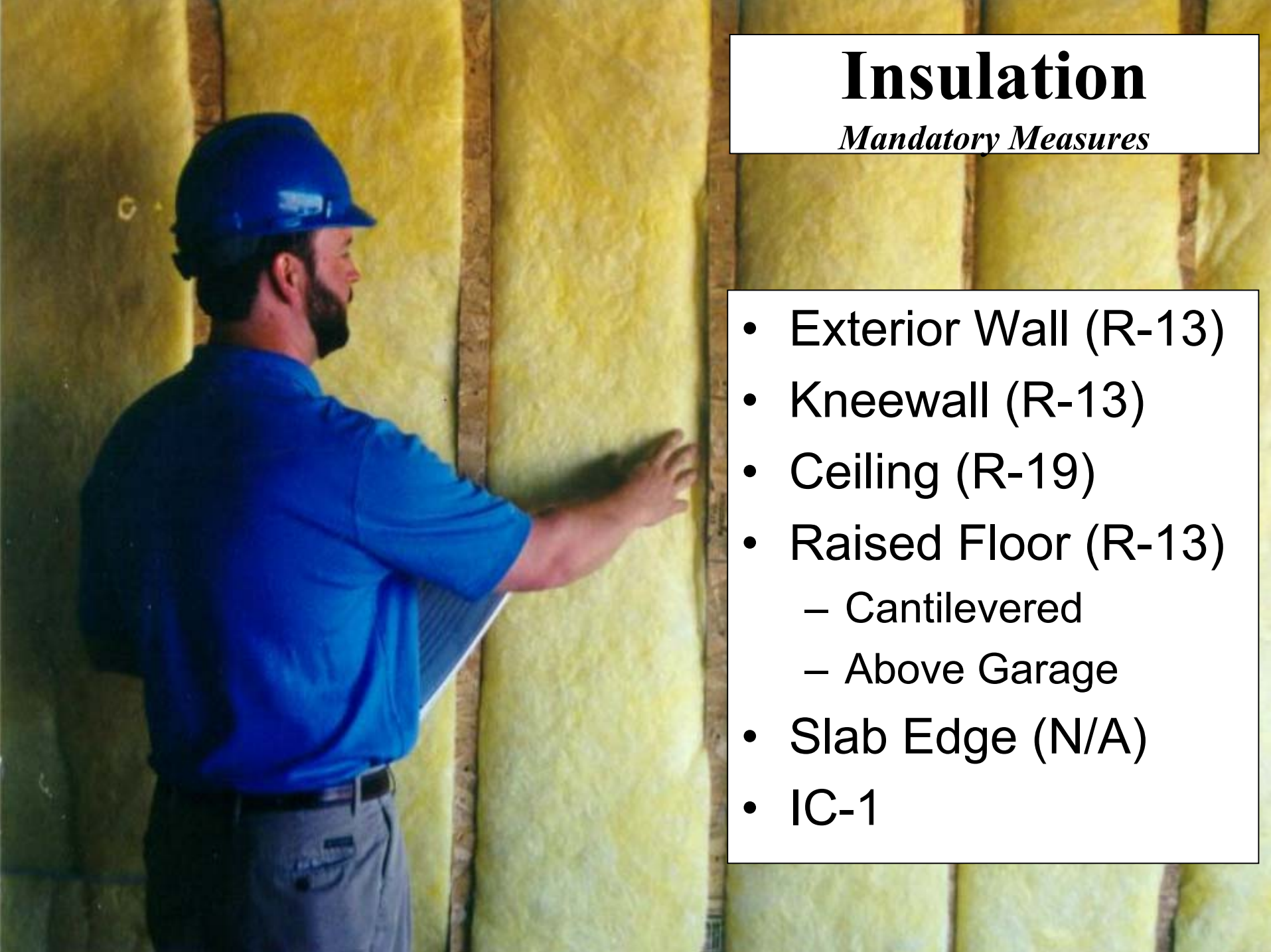
All new residential construction must meet or exceed certain minimum energy efficiency requirements, regardless of the compliance approach. These minimum requirements are referred to in the standards as ***MANDATORY MEASURES.***

- Insulation
- Fenestration
- Infiltration
- Space Conditioning
- Water Heating
- Lighting

# New Mandatory Measures

- No regular old duct tape
  - No cloth-backed, rubber-adhesive tape, unless held by strap or mastic
- Unducted Chases Not Allowed
  - All returns and supplies must be fully ducted
  - Building cavities cannot be used without ducts





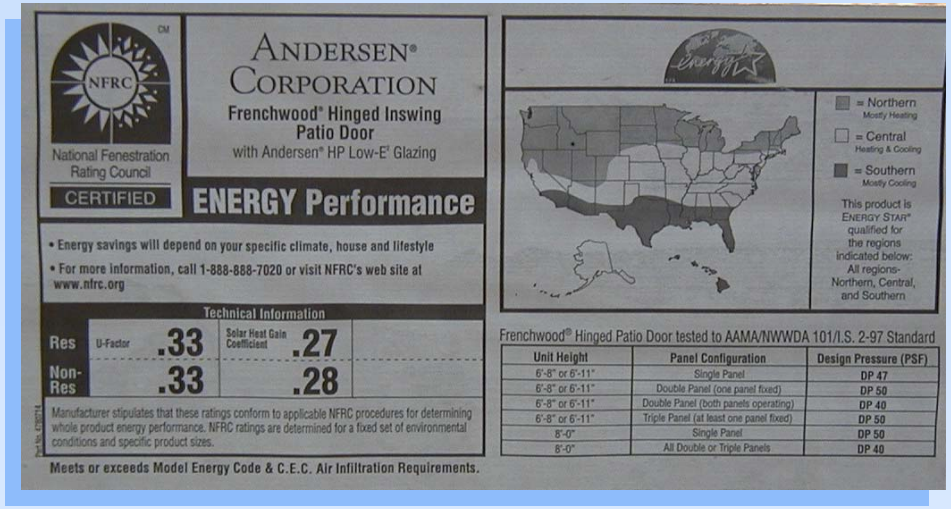
# Insulation

***Mandatory Measures***

- Exterior Wall (R-13)
- Kneewall (R-13)
- Ceiling (R-19)
- Raised Floor (R-13)
  - Cantilevered
  - Above Garage
- Slab Edge (N/A)
- IC-1

# Fenestration

***Mandatory Measures***



NFRC
National Fenestration Rating Council
CERTIFIED

ANDERSEN® CORPORATION
Frenchwood® Hinged Inswing Patio Door
with Andersen® HP Low-E⁴ Glazing

ENERGY Performance

- Energy savings will depend on your specific climate, house and lifestyle
- For more information, call 1-888-888-7020 or visit NFRC's web site at www.nfrc.org

Technical Information

| | U-Factor | Solar Heat Gain Coefficient |
|---|---|---|
| Res | .33 | .27 |
| Non-Res | .33 | .28 |

Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product energy performance. NFRC ratings are determined for a fixed set of environmental conditions and specific product sizes.

Meets or exceeds Model Energy Code & C.E.C. Air Infiltration Requirements.

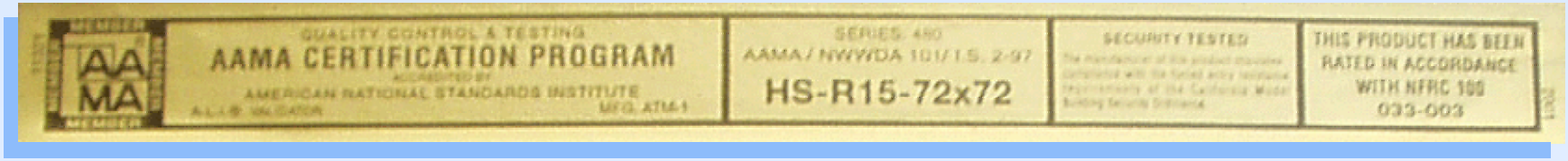
= Northern Mostly Heating
= Central Heating & Cooling
= Southern Mostly Cooling

This product is ENERGY STAR® qualified for the regions indicated below: All regions- Northern, Central, and Southern

Frenchwood® Hinged Patio Door tested to AAMA/NWWDA 101/I.S. 2-97 Standard

| Unit Height | Panel Configuration | Design Pressure (PSF) |
|---|---|---|
| 6'-8" or 6'-11" | Single Panel | DP 47 |
| 6'-8" or 6'-11" | Double Panel (one panel fixed) | DP 50 |
| 6'-8" or 6'-11" | Double Panel (both panels operating) | DP 40 |
| 6'-8" or 6'-11" | Triple Panel (at least one panel fixed) | DP 50 |
| 8'-0" | Single Panel | DP 50 |
| 8'-0" | All Double or Triple Panels | DP 40 |

Temporary Labels



AAMA MEMBER

QUALITY CONTROL & TESTING
AAMA CERTIFICATION PROGRAM
ACCREDITED BY
AMERICAN NATIONAL STANDARDS INSTITUTE
A.L.I. VALIDATOR MFG. ATM-1

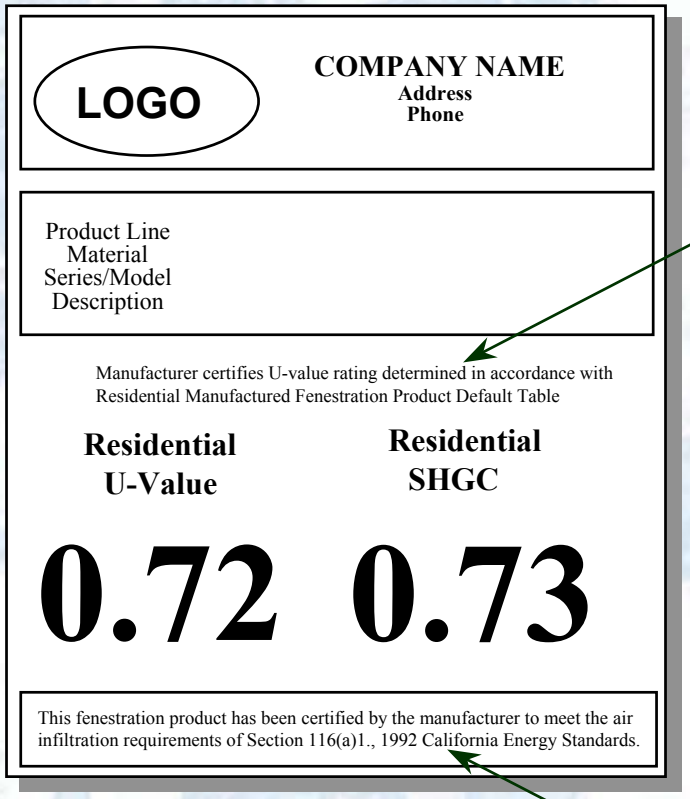
SERIES 480
AAMA / NWWDA 101/ I.S. 2-97
HS-R15-72x72

SECURITY TESTED

THIS PRODUCT HAS BEEN RATED IN ACCORDANCE WITH NFRC 100
033-003

Permanent Labels

# CEC Default Label




Must state U-value is derived from Default Table

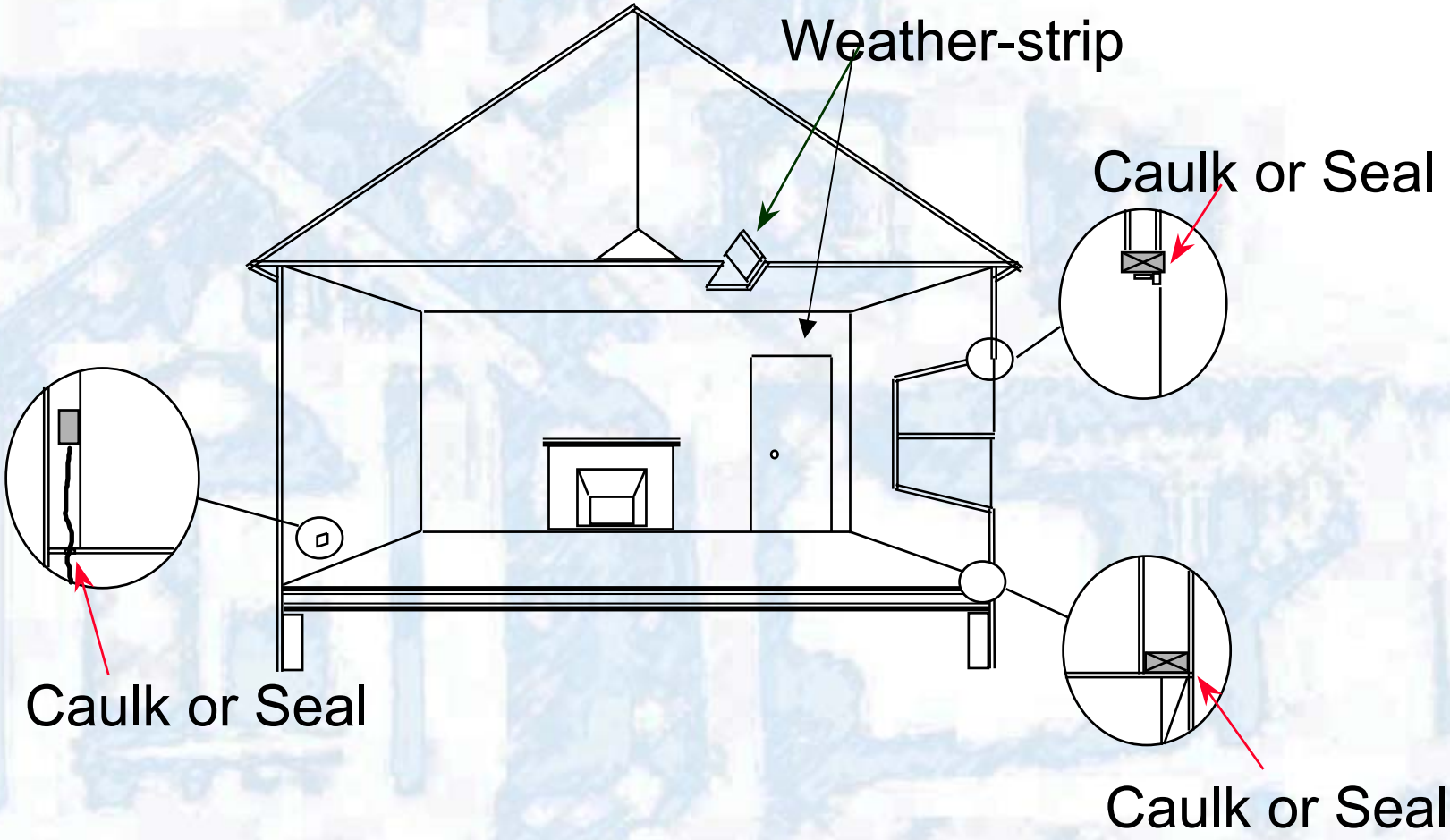
Must include infiltration statement

# Infiltration

***Mandatory Measures***

- Seal all penetrations to unconditioned space.
  - Around window and door frames
  - Any penetrations through top plates
  - Between the sole plate and the subfloor
- Exhaust fans must have back draft damper.
- Fireplace must have closeable doors.

# Caulking & Weather-Stripping



# Space Conditioning

***Mandatory Measures***

- Annual Fuel Utilization Efficiency (AFUE) 78% min
- Seasonal Energy Efficiency Ratio (SEER) 10.0 min
- Duct Insulation – R 4.2
- No Un-Ducted Plenums/Chases
- UL181 Approved Tape & Sealants
  - Cloth-back, rubber-adhesive tape not allowed
- Setback Thermostats
- California Certified Equipment
- CF-6R

# Water Heating

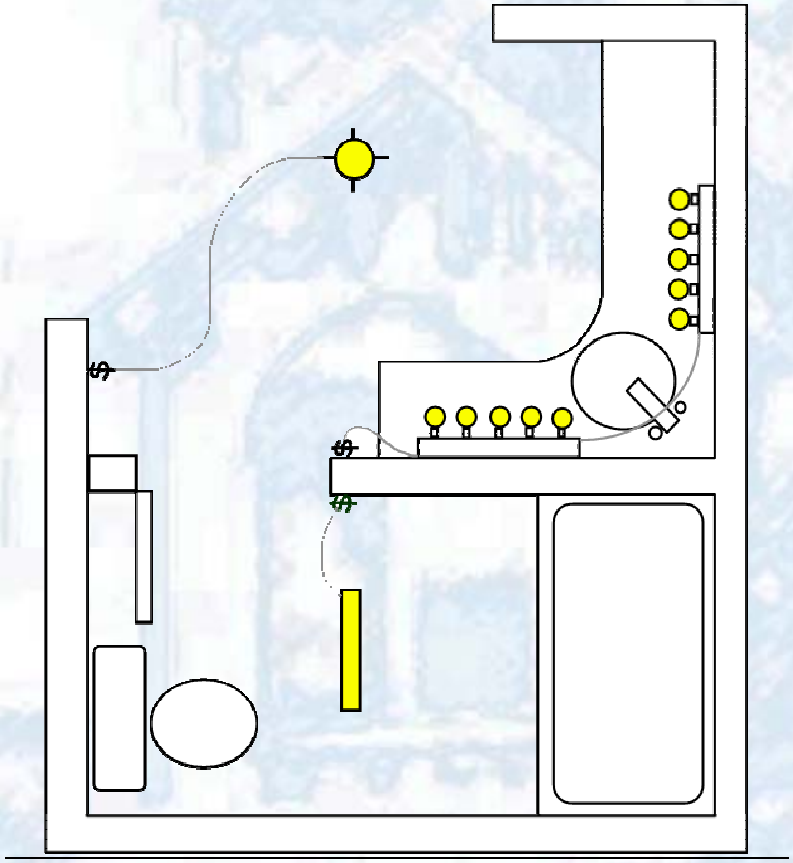
***Mandatory Measures***

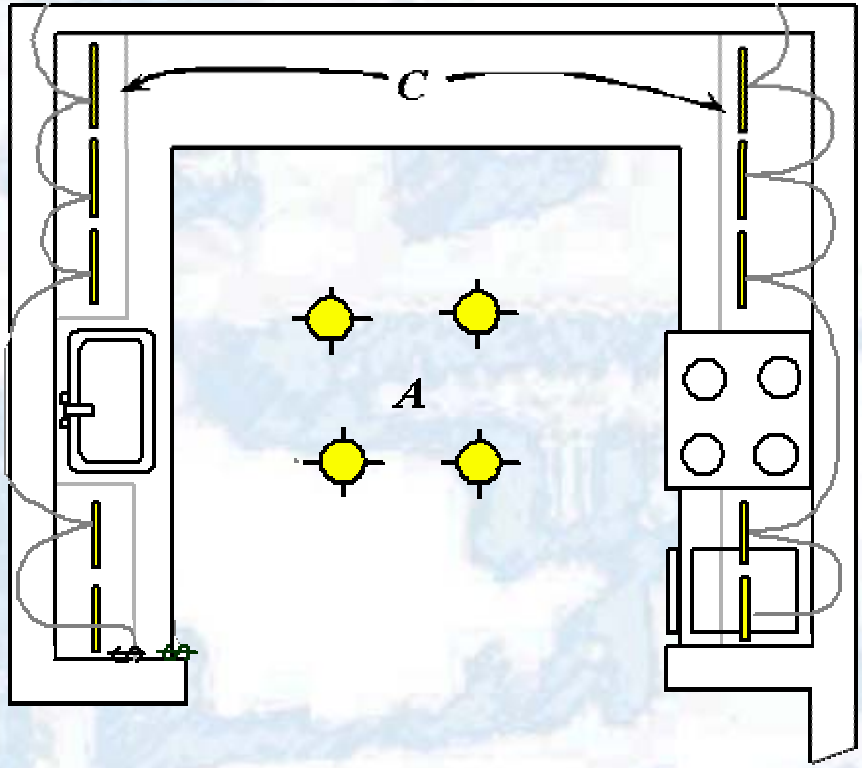
- If EF < 0.58;  R-12 External Blanket
- Low Flow Faucets & Shower Heads
- Re-circulation Pumps - Insulate Hot Water Loop
- Insulate First Five Feet - Hot & Cold
- California Certified Equipment
- CF-6R

# Lighting

***Mandatory Measures***

Kitchen & Bathroom -






***"A" or all of "C" must be fluorescent***

# Methods of Compliance

There are two methods for complying with the *Residential Energy Standards*:

- **Prescriptive Packages**
- **Performance Methods**

**Note: Mandatory Measures apply to both methods.**

# Prescriptive Packages

- Package C (Electric Resistance)
- Package D (Gas or Heat Pump)
- Alternate Package (No 3rd Party Testing)
- Predetermined Features
- Not Flexible
- Documentation Required

Note: Package D forms the basis of the Performance Method.

# Prescriptive Package D

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BUILDING ENVELOPE** | | | | | | | | | | | | | | | | |
| Ceiling | **R38** | **R30** | **R30** | **R30** | **R30** | **R30** | **R30** | **R30** | **R30** | **R30** | **R38** | **R38** | **R38** | **R38** | **R38** | **R38** |
| Walls | **R21** | **R13** | **R13** | **R13** | **R13** | **R13** | **R13** | **R13** | **R13** | **R13** | **R19** | **R19** | **R19** | **R21** | **R21** | **R21** |
| "Heavy mass" walls | **R4.76** | **R2.44** | **R2.44** | **R2.44** | **R2.44** | **R2.44** | **R2.44** | **R2.44** | **R2.44** | **R2.44** | **R4.76** | **R4.76** | **R4.76** | **R4.76** | **R4.76** | **R4.76** |
| Below-grade walls | **R0** | **R0** | **R0** | **R0** | **R0** | **R0** | **R0** | **R0** | **R0** | **R0** | **R0** | **R0** | **R0** | **R0** | **R0** | **R13** |
| Slab floor perimeter | **NR** | **NR** | **NR** | **NR** | **NR** | **NR** | **NR** | **NR** | **NR** | **NR** | **NR** | **NR** | **NR** | **NR** | **NR** | **R7** |
| Raised floors | **R19** | **R19** | **R19** | **R19** | **R19** | **R19** | **R19** | **R19** | **R19** | **R19** | **R19** | **R19** | **R19** | **R19** | **R19** | **R19** |
| Concrete raised floors | **R8** | **R8** | **R0** | **R0** | **R0** | **R0** | **R0** | **R0** | **R0** | **R0** | **R8** | **R4** | **R8** | **R8** | **R4** | **R8** |
| Radiant Barrier | **NR** | **REQ** | **NR** | **REQ** | **NR** | **NR** | **NR** | **REQ** | **REQ** | **REQ** | **REQ** | **REQ** | **REQ** | **REQ** | **REQ** | **NR** |
| **GLAZING** | | | | | | | | | | | | | | | | |
| Maximum U-factor | **0.65** | **0.65** | **0.75** | **0.75** | **0.75** | **0.75** | **0.75** | **0.75** | **0.75** | **0.65** | **0.65** | **0.65** | **0.65** | **0.65** | **0.65** | **0.60** |
| Maximum total area | **16%** | **16%** | **20%** | **20%** | **16%** | **20%** | **20%** | **20%** | **20%** | **20%** | **16%** | **16%** | **16%** | **16%** | **16%** | **16%** |
| **Solar Heat Gain Coefficient** | | | | | | | | | | | | | | | | |
| South-facing glazing | **NR** | **0.40** | **NR** | **0.40** | **NR** | **NR** | **0.40** | **0.40** | **0.40** | **0.40** | **0.40** | **0.40** | **0.40** | **0.40** | **0.40** | **NR** |
| **SPACE-COOLING SYSTEM** | | | | | | | | | | | | | | | | |
| Refrigerant charge and airflow testing or TXV | **NR** | **REQ*** | **NR** | **NR** | **NR** | **NR** | **NR** | **REQ*** | **REQ*** | **REQ*** | **REQ*** | **REQ*** | **REQ*** | **REQ*** | **REQ*** | **NR** |
| **SPACE CONDITIONING DUCTS** | | | | | | | | | | | | | | | | |
| Duct Sealing | **REQ*** | **REQ*** | **REQ*** | **REQ*** | **REQ*** | **REQ*** | **REQ*** | **REQ*** | **REQ*** | **REQ*** | **REQ*** | **REQ*** | **REQ*** | **REQ*** | **REQ*** | **REQ*** |

* HERS rater field verification and diagnostic testing are required for this feature. As an alternative under Package D, better glazing and higher efficiency equipment can be used instead of the diagnostic testing of air distribution ducts, split system air conditioners and heat pumps. See Table 3-2 for the increased values, which vary by climate.

NR = Not Required REQ = Required MIN = Minimum

# Prescriptive Package D

## Climate Zone 1

| *(Insulation Minimums)* | | *(Space Heating)* | |
|---|---|---|---|
| Ceiling | R-38 | Electric-resistant allowed | No |
| Walls | R-21 | If gas, AFUE = | Min |
| Raised Floors | R-19 | If heat pump, Split HSPF | Min |
| Radiant Barrier | Req | If heat pump, Package HSPF | Min |

| *(Glazing Maximums)* | | *(Space Cooling)* | |
|---|---|---|---|
| Total Area | 16% | If split, SEER = | Min |
| U-Factor | 0.65 | If package, SEER = | Min |
| SHGC | NR | RCA or TXV | NR |

*(Space Conditioning Ducts)*

Duct Sealing Req*

*Alternative Package Available

# Prescriptive Package D

## Climate Zone 2

| *(Insulation Minimums)* | | *(Space Heating)* | |
|---|---|---|---|
| Ceiling | R-30 | Electric-resistant allowed | No |
| Walls | R-13 | If gas, AFUE = | Min |
| Raised Floors | R-19 | If heat pump, Split HSPF | Min |
| Radiant Barrier | NR | If heat pump, Package HSPF | Min |

| *(Glazing Maximums)* | | *(Space Cooling)* | |
|---|---|---|---|
| Total Area | 16% | If split, SEER = | Min |
| U-Factor | 0.65 | If package, SEER = | Min |
| SHGC | 0.40 | RCA or TXV | Req* |

*(Space Conditioning Ducts)*

Duct Sealing Req*

*Alternative Package Available

# Prescriptive Package D

Climate Zone 3, 6

| *(Insulation Minimums)* | | *(Space Heating)* | |
|---|---|---|---|
| Ceiling | R-30 | Electric-resistant allowed | No |
| Walls | R-13 | If gas, AFUE = | Min |
| Raised Floors | R-19 | If heat pump, Split HSPF | Min |
| Radiant Barrier | NR | If heat pump, Package HSPF | Min |

| *(Glazing Maximums)* | | *(Space Cooling)* | |
|---|---|---|---|
| Total Area | 20% | If split, SEER = | Min |
| U-Factor | 0.75 | If package, SEER = | Min |
| SHGC | NR | RCA or TXV | NR |

*(Space Conditioning Ducts)*

Duct Sealing Req*

*Alternative Package Available

# Prescriptive Package D

## Climate Zone 4

| *(Insulation Minimums)* | | *(Space Heating)* | |
|---|---|---|---|
| Ceiling | R-30 | Electric-resistant allowed | No |
| Walls | R-13 | If gas, AFUE = | Min |
| Raised Floors | R-19 | If heat pump, Split HSPF | Min |
| Radiant Barrier | Req | If heat pump, Package HSPF | Min |

| *(Glazing Maximums)* | | *(Space Cooling)* | |
|---|---|---|---|
| Total Area | 20% | If split, SEER = | Min |
| U-Factor | 0.75 | If package, SEER = | Min |
| SHGC | 0.40 | RCA or TXV | NR |

*(Space Conditioning Ducts)*

Duct Sealing Req*

*Alternative Package Available

# Prescriptive Package D

## Climate Zone 5

| *(Insulation Minimums)* | | *(Space Heating)* | |
|---|---|---|---|
| Ceiling | R-30 | Electric-resistant allowed | No |
| Walls | R-13 | If gas, AFUE = | Min |
| Raised Floors | R-19 | If heat pump, Split HSPF | Min |
| Radiant Barrier | NR | If heat pump, Package HSPF | Min |

| *(Glazing Maximums)* | | *(Space Cooling)* | |
|---|---|---|---|
| Total Area | 16% | If split, SEER = | Min |
| U-Factor | 0.75 | If package, SEER = | Min |
| SHGC | NR | RCA or TXV | NR |

*(Space Conditioning Ducts)*

Duct Sealing Req*

*Alternative Package Available

# Prescriptive Package D

## Climate Zone 7

| *(Insulation Minimums)* | | *(Space Heating)* | |
|---|---|---|---|
| Ceiling | R-30 | Electric-resistant allowed | No |
| Walls | R-13 | If gas, AFUE = | Min |
| Raised Floors | R-19 | If heat pump, Split HSPF | Min |
| Radiant Barrier | NR | If heat pump, Package HSPF | Min |

| *(Glazing Maximums)* | | *(Space Cooling)* | |
|---|---|---|---|
| Total Area | 20% | If split, SEER = | Min |
| U-Factor | 0.75 | If package, SEER = | Min |
| SHGC | 0.40 | RCA or TXV | NR |

*(Space Conditioning Ducts)*

Duct Sealing Req*

*Alternative Package Available

# Prescriptive Package D

Climate Zone 8, 9

| *(Insulation Minimums)* | | *(Space Heating)* | |
|---|---|---|---|
| Ceiling | R-30 | Electric-resistant allowed | No |
| Walls | R-13 | If gas, AFUE = | Min |
| Raised Floors | R-19 | If heat pump, Split HSPF | Min |
| Radiant Barrier | Req* | If heat pump, Package HSPF | Min |

| *(Glazing Maximums)* | | *(Space Cooling)* | |
|---|---|---|---|
| Total Area | 20% | If split, SEER = | Min |
| U-Factor | 0.75 | If package, SEER = | Min |
| SHGC | 0.40 | RCA or TXV | Req* |

*(Space Conditioning Ducts)*

Duct Sealing Req*

*Alternative Package Available

# Prescriptive Package D

## Climate Zone 10

| *(Insulation Minimums)* | | *(Space Heating)* | |
|---|---|---|---|
| Ceiling | R-30 | Electric-resistant allowed | No |
| Walls | R-13 | If gas, AFUE = | Min |
| Raised Floors | R-19 | If heat pump, Split HSPF | Min |
| Radiant Barrier | Req* | If heat pump, Package HSPF | Min |

| *(Glazing Maximums)* | | *(Space Cooling)* | |
|---|---|---|---|
| Total Area | 20% | If split, SEER = | Min |
| U-Factor | 0.65 | If package, SEER = | Min |
| SHGC | 0.40 | RCA or TXV | Req* |

*(Space Conditioning Ducts)*

Duct Sealing Req*

*Alternative Package Available

# Prescriptive Package D

## Climate Zone 11, 12, 13

| *(Insulation Minimums)* | | *(Space Heating)* | |
|---|---|---|---|
| Ceiling | R-38 | Electric-resistant allowed | No |
| Walls | R-19 | If gas, AFUE = | Min |
| Raised Floors | R-19 | If heat pump, Split HSPF | Min |
| Radiant Barrier | Req* | If heat pump, Package HSPF | Min |

| *(Glazing Maximums)* | | *(Space Cooling)* | |
|---|---|---|---|
| Total Area | 16% | If split, SEER = | Min |
| U-Factor | 0.65 | If package, SEER = | Min |
| SHGC | 0.40 | RCA or TXV | Req* |

*(Space Conditioning Ducts)*

Duct Sealing Req*

*Alternative Package Available

# Prescriptive Package D

## Climate Zone 16

| *(Insulation Minimums)* | | *(Space Heating)* | |
|---|---|---|---|
| Ceiling | R-38 | Electric-resistant allowed | No |
| Walls | R-19 | If gas, AFUE = | Min |
| Raised Floors | R-19 | If heat pump, Split HSPF | Min |
| Radiant Barrier | NR | If heat pump, Package HSPF | Min |
| Slab Perimeter | R-7 | | |

| *(Glazing Maximums)* | | *(Space Cooling)* | |
|---|---|---|---|
| Total Area | 16% | If split, SEER = | Min |
| U-Factor | 0.60 | If package, SEER = | Min |
| SHGC | NR | RCA or TXV | NR |

*(Space Conditioning Ducts)*

| | |
|---|---|
| Duct Sealing | Req* |

*Alternative Package Available

# Alternate to Package D

If the builder does not want to do the field verification and diagnostic testing, then an alternative set of requirements are available that require more energy efficient fenestration and space conditioning equipment.

| *Climate Zone* | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* | *11* | *12* | *13* | *14* | *15* | *16* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GLAZING** | | | | | | | | | | | | | | | | |
| Maximum U-factor | **0.55** | **0.40** | **0.55** | **0.40** | **0.55** | **0.55** | **0.40** | **0.40** | **0.40** | **0.40** | **0.40** | **0.40** | **0.40** | **0.40** | **0.40** | **0.55** |
| SHGC | **NR** | **0.35** | **NR** | **0.35** | **NR** | **NR** | **0.35** | **0.35** | **0.35** | **0.35** | **0.35** | **0.35** | **0.35** | **0.30** | **0.30** | **NR** |
| | | | | | | | | | | | | | | | | |
| **Space Conditioning** | | | | | | | | | | | | | | | | |
| SEER | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **11.0** | **11.0** | **11.0** | **11.0** | **12.0** | **12.0** | **13.0** | **Min** |
| AFUE or | **90** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **90** |
| HSPF | **7.6** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **Min** | **7.6** |

# Performance Method

## (Computer Method)

- CEC Approved Software
  - Micropas Version 6.01
  - EnergyPro Version 3.1
  - CalRes 2 Version 1.4
- Flexible
- Standard Design (Prescriptive Package D)
- Proposed Design
- Mandates Master Plan Approach
  - Limited by worst case orientation
  - Limited by worst case option (Most glazing / CFA)
- Documentation Required

# C2R page (Energy Budget)

```
COMPUTER METHOD SUMMARY                                    Page 1          C-2R
==============================================================================
Project Title.......... PLAN 1                          Date..04/08/02 13:04:30
Project Address........ GRIFFIN ENCORE          *******  ---------------------
                        RIVERSIDE CO - CZ 10     *v6.01*  | _________________ |
Documentation Author... CM                       *******  | Building Permit # |
                        ConSol                            | _________________ |
                        7407 Tam O'Shanter Dr Ste 200     | Plan Check / Date |
                        Stockton, CA  95210               | _________________ |
                        209-474-8446                      | Field Check/ Date |
Climate Zone........... 10                                ---------------------
Compliance Method...... MICROPAS6 v6.01 for 2001 Standards by Enercomp, Inc.
==============================================================================
|        MICROPAS6 v6.01  File-G1  Wth-CTZ10S92  Program-FORM C-2R            |
|            User#-MP0105  User-ConSol  Run-20% Incentive Review              |
------------------------------------------------------------------------------

       ==================================================================
       =                  MICROPAS6 ENERGY USE SUMMARY                  =
       =                  ----------------------------                  =
       =  Energy Use                Standard    Proposed   Compliance  =
       =  (kBtu/sf-yr)               Design      Design      Margin    =
       =  -----------------------  ----------  ----------  ----------  =
       =  Space Heating..........      9.69        6.91        2.78    =
       =  Space Cooling..........     11.39        7.90        3.49    =
       =  Water Heating..........     11.94        9.89        2.05    =
       =                            --------    --------    --------   =
       =              North Total     33.02       24.70        8.32    =
       =                                                               =
       =  Space Heating..........      9.69        7.56        2.13    =
       =  Space Cooling..........     11.39        8.19        3.20    =
       =  Water Heating..........     11.94        9.89        2.05    =
       =                            --------    --------    --------   =
       =               East Total     33.02       25.64        7.38    =
       =                                                               =
       =  Space Heating..........      9.69        7.77        1.92    =
       =  Space Cooling..........     11.39        6.65        4.74    =
       =  Water Heating..........     11.94        9.89        2.05    =
       =                            --------    --------    --------   =
       =              South Total     33.02       24.31        8.71    =
       =                                                               =
       =  Space Heating..........      9.69        7.17        2.52    =
       =  Space Cooling..........     11.39        7.75        3.64    =
       =  Water Heating..........     11.94        9.89        2.05    =
       =                            --------    --------    --------   =
       =               West Total     33.02       24.81        8.21    =
       =                                                               =
       =      *** Building complies with Computer Performance ***      =
              ==================================================================
```

# 2001 T24 Changes

- 12% Increase in Stringency of Title 24

| Climate Zone | Glazing | | Roof | Duct Seal | A/C Coil | % Change |
|---|---|---|---|---|---|---|
| | U-value | SHGC | | | | |
| 1 | | | | Sealed | | 5% |
| 2 | | 0.40 | RB | Sealed | TXV | 11% |
| 3 | | | | Sealed | | 4% |
| 4 | | 0.40 | RB | Sealed | | 12% |
| 5 | | | | Sealed | | 4% |
| 6 | | | | Sealed | | 3% |
| 7 | | 0.40 | | Sealed | | 11% |
| 8 | | 0.40 | RB | Sealed | TXV | 14% |
| 9 | | 0.40 | RB | Sealed | TXV | 18% |
| 10 | 0.65 | 0.40 | RB | Sealed | TXV | 20% |
| 11 | | 0.40 | RB | Sealed | TXV | 14% |
| 12 | | 0.40 | RB | Sealed | TXV | 11% |
| 13 | | 0.40 | RB | Sealed | TXV | 16% |
| 14 | | 0.40 | RB | Sealed | TXV | 15% |
| 15 | | 0.40 | RB | Sealed | TXV | 23% |
| 16 | | | | Sealed | | 8% |
| | | | | | Average | 12% |

# Flexible Features: Opaque Surfaces

- **Exceed the Package D Requirement**
  - **Increase insulation R-value**
  - **Decrease the assembly's U-factor**
  - **Form 3R required for Non-Standard Assemblies**
- **Tight Infiltration Credit**
  - **Requires Third-Party Certification.**
- **Radiant Barrier**
  - **Applied to Roof Deck & Gable ends**
- **Cool Roof**
  - **Low emissivity roof**

# Opaque Surfaces: Wall

- High Density Batts
- Expanded Polystyrene (One Coat Stucco)
- 2X6 Walls
- Wood Siding
- Special Assemblies (Form 3R)

# Opaque Surfaces: Roof & Attic

- At Furnace
- Vault
- Rafter
- Attic
- Radiant Barrier
- Cool Roof

# Quality Construction: Batt Insulation

- Less effective when compressed.

| Standard R-Value | Nominal Lumber Size | Actual Cavity Depth | Installed R-Value |
|---|---|---|---|
| 13 (3.625") | 2x4 | 3.5" | 13 |
| 15 (3.5”) | 2x4 | 3.5 | 15 |
| 19 (6.25") | 2x6 | 5.5 | 17.8 |
| 21 (5.5”) | 2x6 | 5.5 | 21 |
| 22 (6.75") | 2x6 | 5.5" | 20 |
| 30 (9.5") | 2x10 | 9.25" | 30 |
| 38 (12") | 2x12 | 11.25" | 37 |

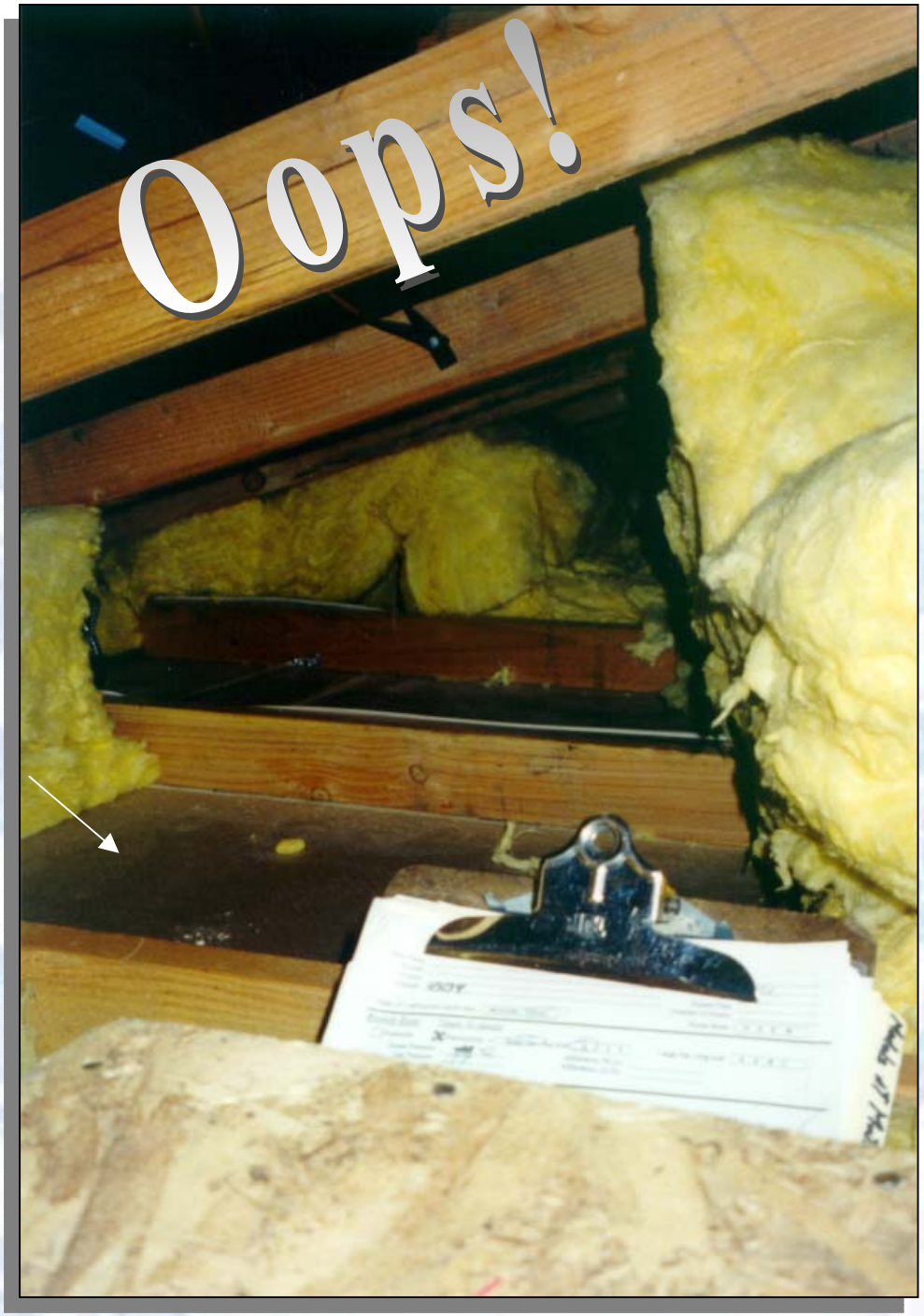
# Quality Construction: Batt Insulation

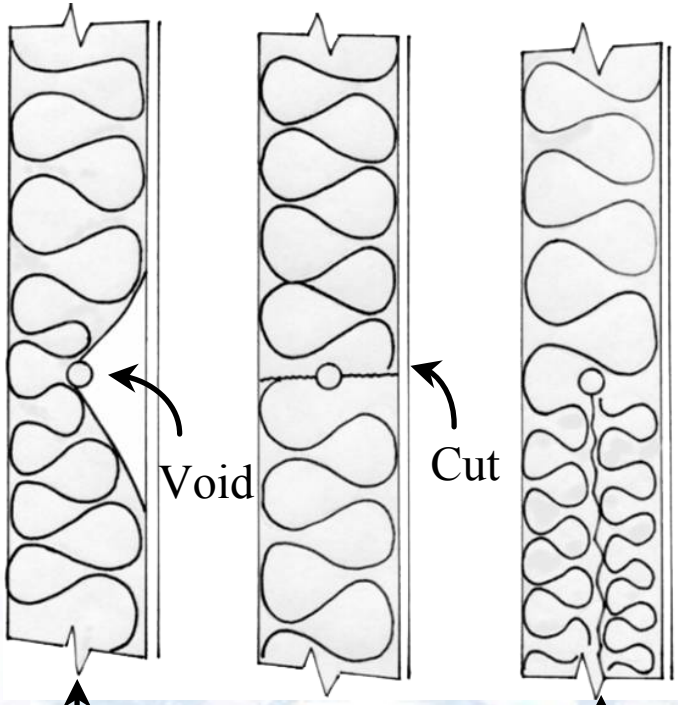
- Corners -- Avoid or Insulate
  - Large voids at wall intersections
- Avoid Gaps and Compression
  - Cut and butt around wiring and plumbing
  - If cavity less than standard width, cut batt to fit cavity
  - Maximum 1” wider than cavity
- Kneewalls and Skylight Shafts
  - Quality:  minimum R-19
- Stapling
  - On stud face, follow manufacturer’s specifications
- Ceilings
  - Use full-width batts that cover truss members
  - Avoid tunnels under insulation
  - Avoid gaps

# Poor Batt Installation

Compression

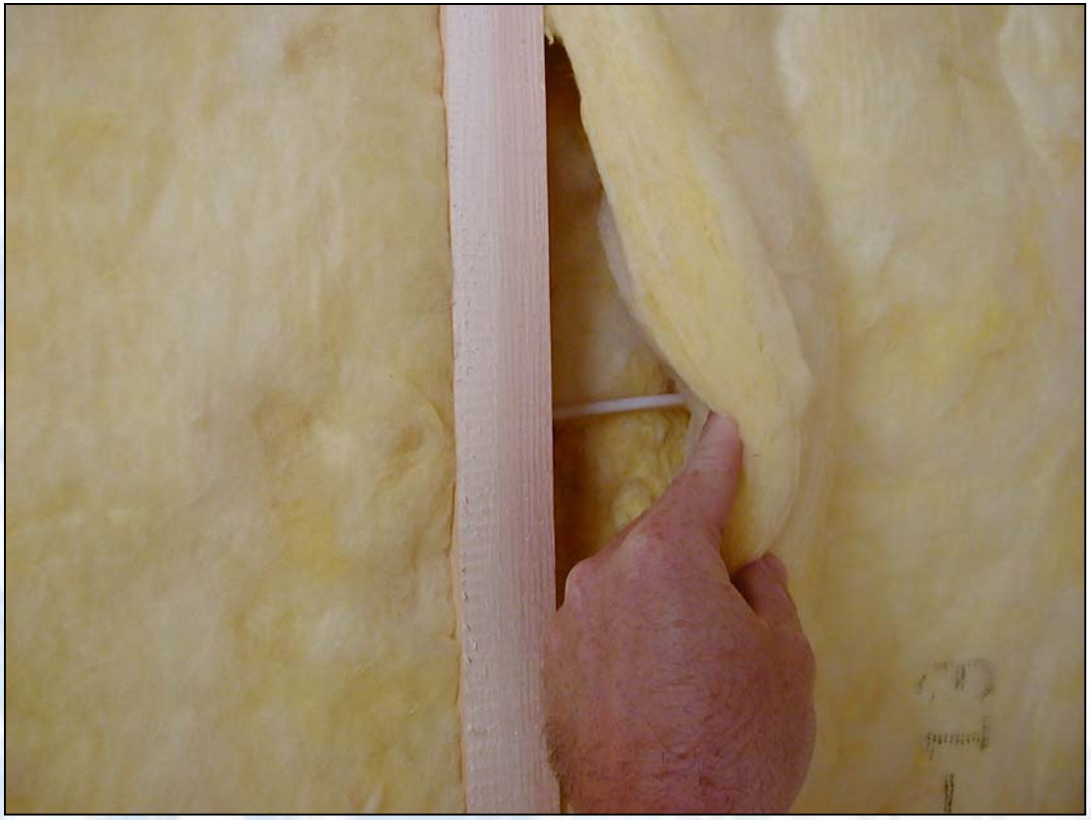
Batts cut incorrectly


Oops!




Poor Quality

Split: BEST QUALITY



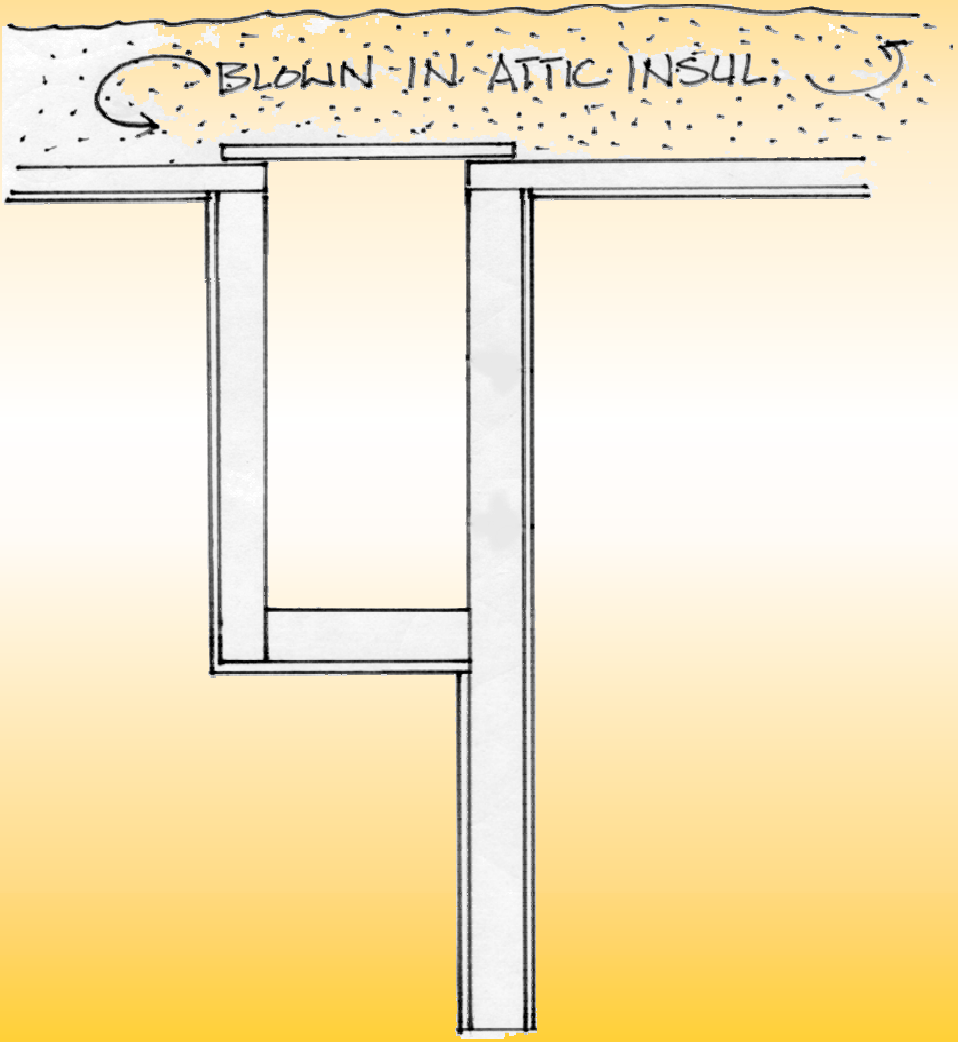
# Quality Installation

# Uninsulated Channels & Corners

# Quality Construction: Loose Fill Insulation

- Allow for settling
- Covers on drops and cavities
- Even, correct depth
- Depth stick for every 250 square feet
- Cover top plates
- Baffle eave and soffit vents
- Block insulation away from chimneys
- Insulate under HVAC attic platform
- Insulate attic hatch with batt or rigid

# Hard Covers or Drops

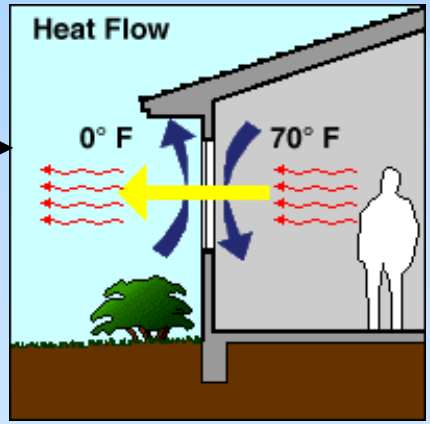


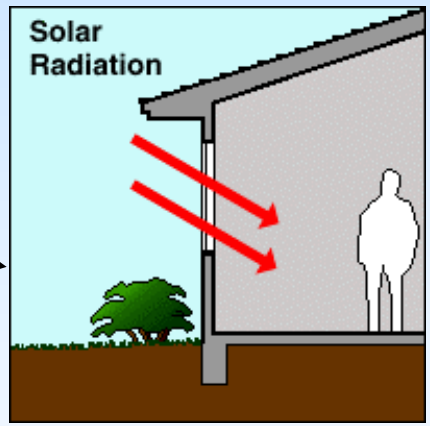
# Quality Construction: Infiltration & Ventilation

- Default Specific Leakage Area (SLA) is 4.9
- Credit given is proportional to how low SLA.
  - Must be certified by installer
  - Must be HERS tested & certified
- If 2.0 SLA is *specified* on T-24 then mechanical ventilation is required.
- If 1.5 SLA or less is *measured* then mechanical ventilation is required.
- Owner documentation must include operating instructions for windows or mechanical ventilation.

# Flexible Features: Fenestration

- Exceed Package D
  - U-Factor
  - SHGC
- Frame Type
  - Metal / Vinyl / Wood
  - Thermal Break
- Glass Coatings
  - Lowers SHGC
  - Lowers U-factor
- Gas Filled
- Overhangs / Side Fins



# Low SHGC Glass

- Reflects sun's heat
- Reduces heat loss
- Reduces energy bills
- Allows visible light w/o tint
- Blocks infrared and ultraviolet solar energy that damages furnishings, fabrics …
- Correct size A/C to window type

# Flexible Features: Space Conditioning

- Increase Above Package D
  - SEER
  - AFUE or HSPF
  - Duct Insulation
- Zonal Control
- Third Party Inspections
  - Duct Leakage
  - TXV
  - ACCA Manual D
  - 12’ Outside Conditioned Space
  - Inside Conditioned Space

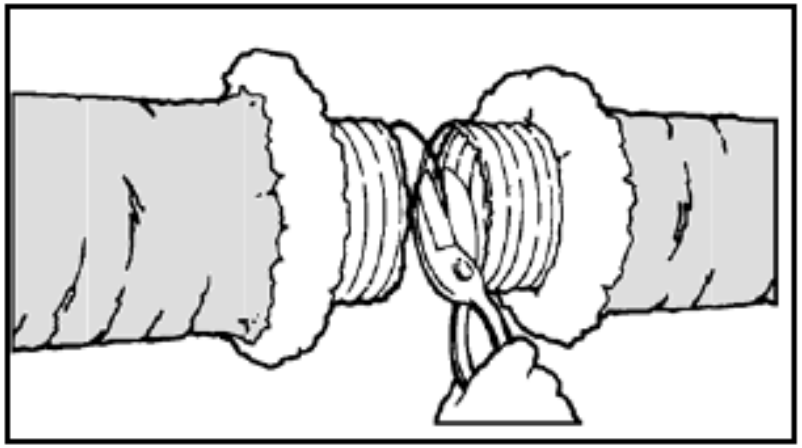
# Increased Efficiency

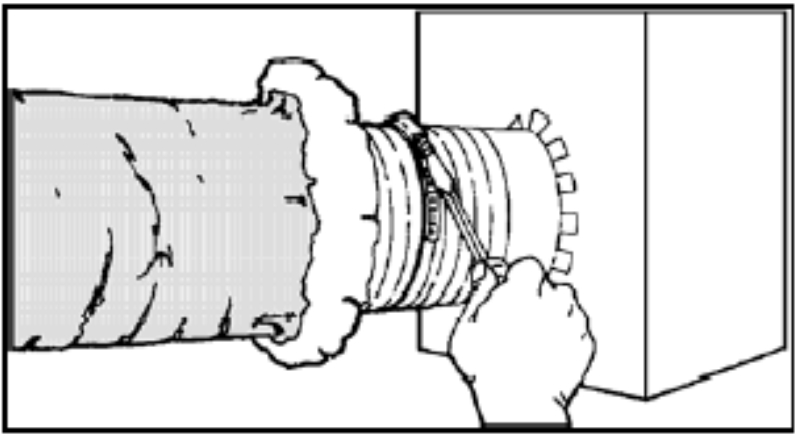
- SEER / EER
- AFUE
- Duct Insulation
- Zonal Control

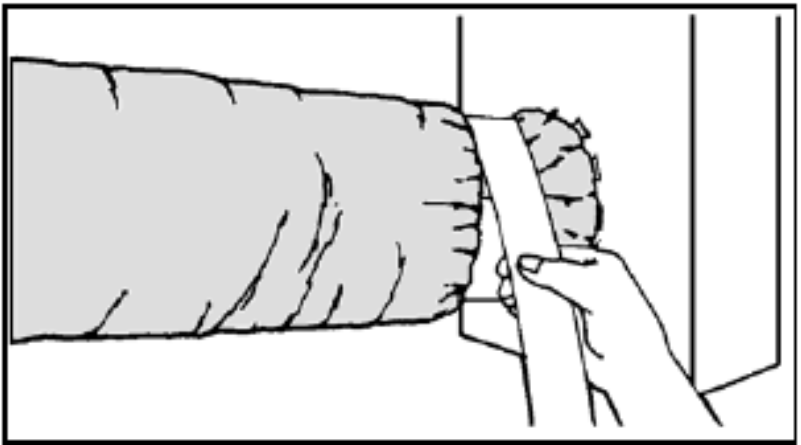
# Quality Construction: Sealed Ducts

- Mechanical Connection
  - Compression Strap
    - UV Resistant Nylon Duct Ties
    - Stainless Steel Worm-Drive Hose Clamps
- Duct Sealing
  - UL 181 Approved Materials
    - Mastic
    - Butyl Back, Mylar, Aluminized Tapes
  - Less than 6% of Fan Flow
  - Installer Certified & CHEERS Tested
- No excessive turns or constrictions

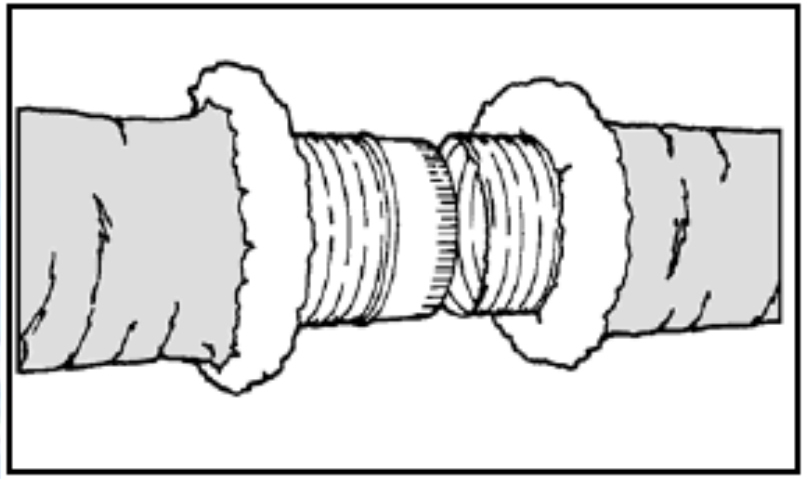
# Duct to Plenum/ Boot

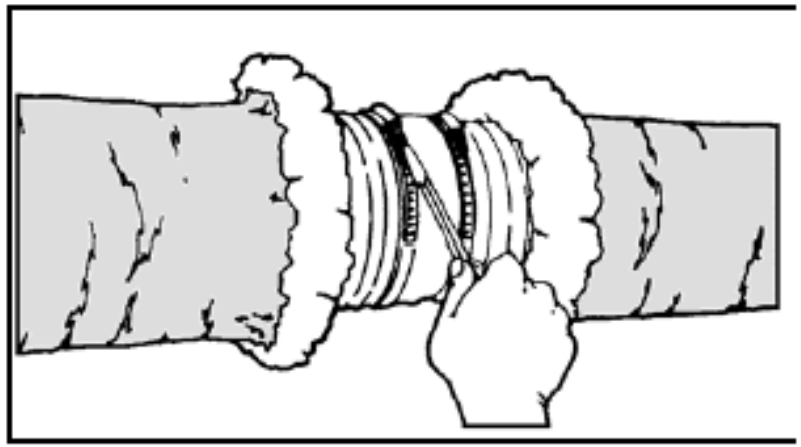


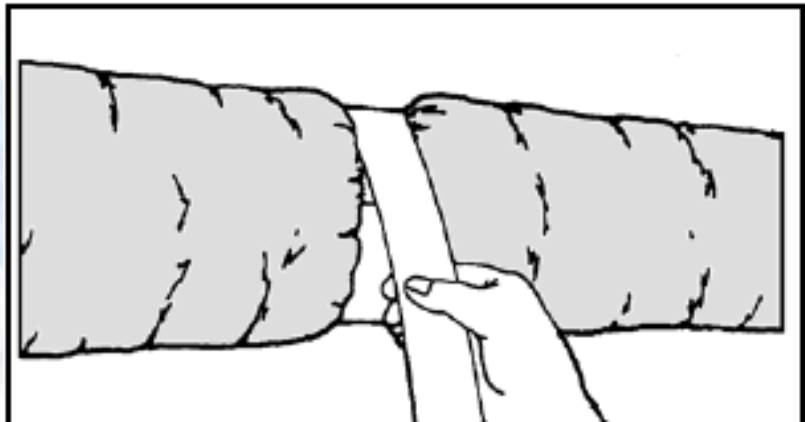




# Duct to Duct

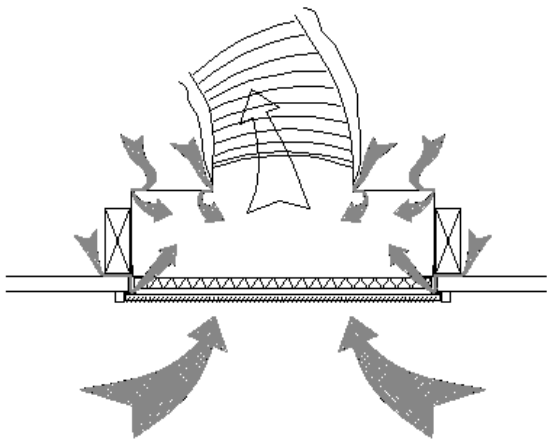


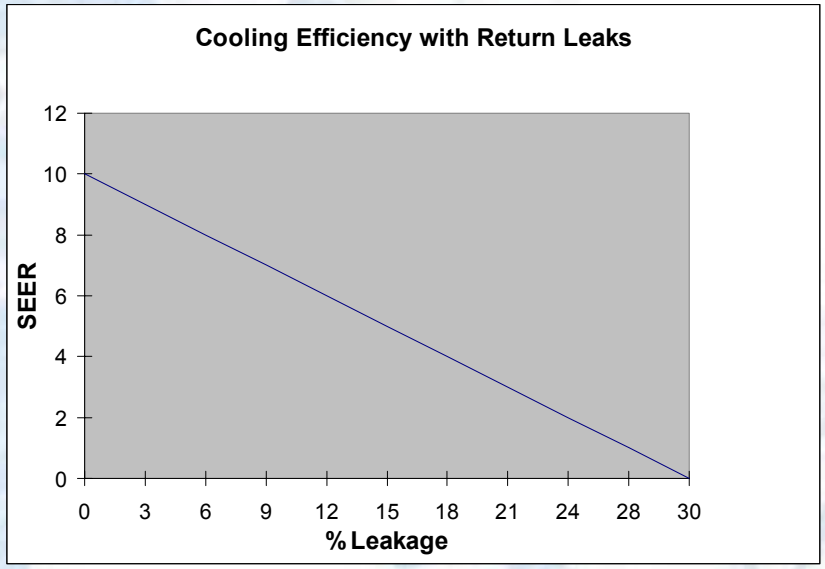




# Return Air Leakage

Field Fabricated Return






At 120 deg Attic Temp.

# Butterfly Collar

Mastic

# Zip Tie

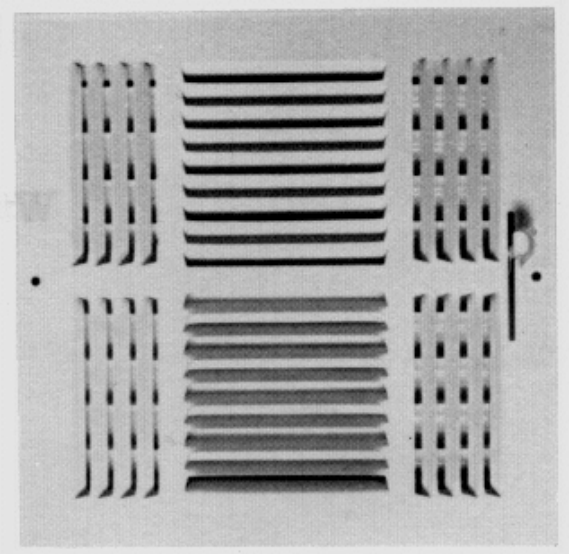
# Quality Construction: ACCA HVAC Design

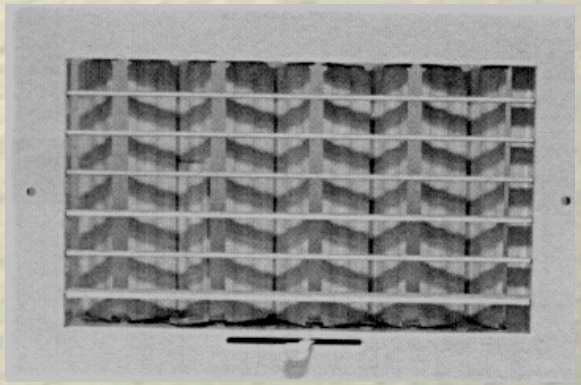
- ACCA Manual J - Load Calculations
  - Room by room loads → room air requirements
  - Worst case orientation → worst case total load

- ACCA Manual S - Equipment Sizing
  - Use correct design conditions for capacities
  - Size Furnace for adequate airflow to AC

# Quality Construction: ACCA HVAC Design

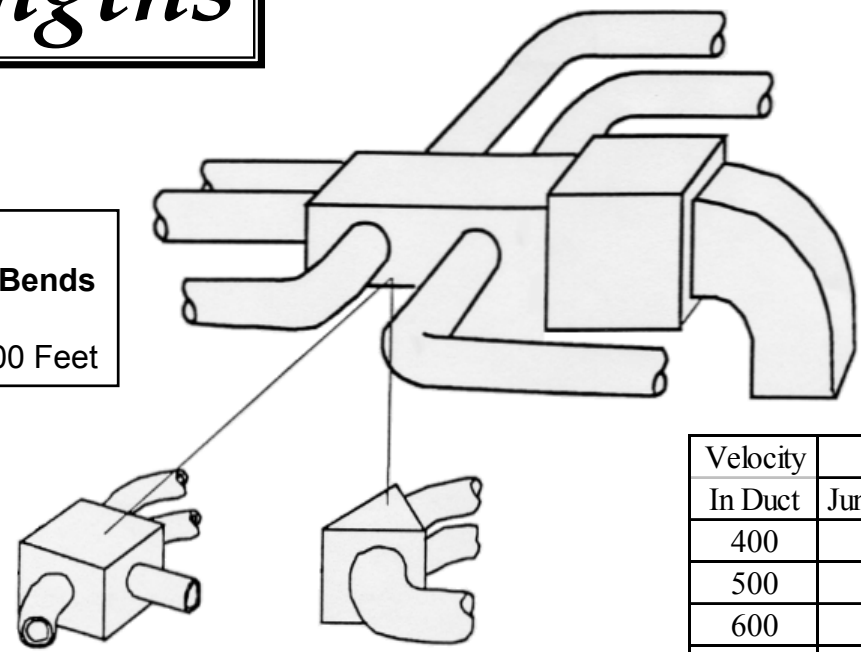
- ACCA Manual D - Duct Sizing
  - Takes into account ALL friction losses
  - Takes into account available pressure from fan
  - Sizes ducts according to room load
  - Balances supply and return
- Register Selection
  - Function and aesthetics
  - Throw distance and noise
- No Unducted Plenums or Chases
  - Uncontrollable leakage
  - Introduction of polluted air





# *Equivalent Lengths*

**Group 11**
**Flexible Duct Junction Boxes and Radius Bends**
Reference Velocity = As Indicated
Reference Friction Rate = 0.08 in. Wg. Per 100 Feet



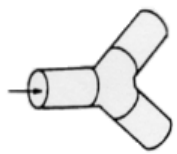
| Velocity | EL Values | |
|---|---|---|
| In Duct | Junction Box | 90° Bend |
| 400 | 35 | 5 |
| 500 | 50 | 7 |
| 600 | 75 | 10 |
| 700 | 100 | 15 |
| 800 | 125 | 20 |
| 900 | 150 | 25 |

For bends that are not equal to 90°, multiply the90 equivalent length by the ratio of the desired angle to the 90 angle.

Example: Find EL for a 45 bend if the velocity equals 700 FPM

15 x 45 / 90 = 7.5 ft

| | EL |
|---|---|
| Branch | 25 |
| Main | 5 |



EL = 15

# Tight Strap

# Pinched in Truss

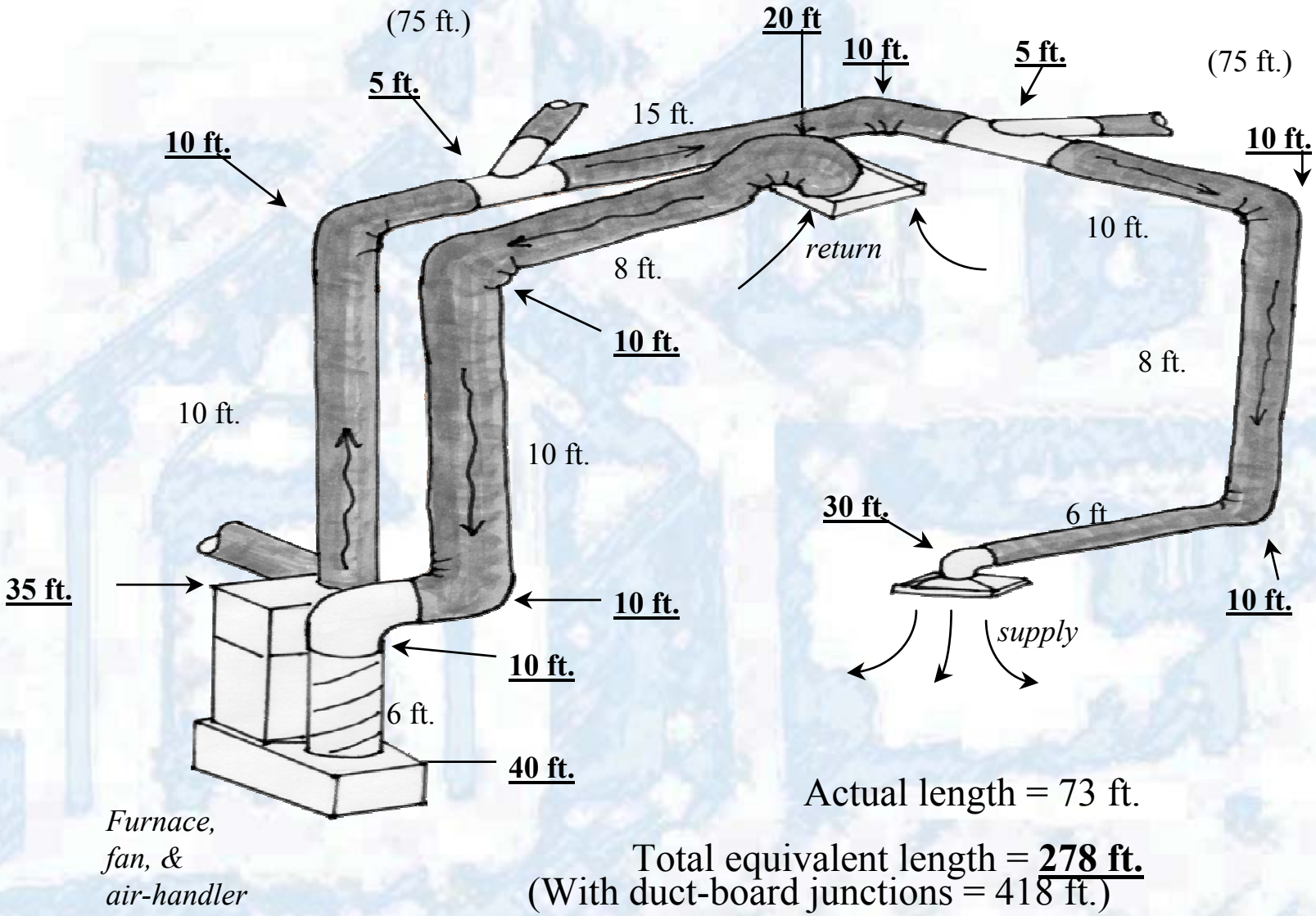
Restrictive Bend

Quality Installation

Pinched Return

Effective Opening

# Equivalent Duct Lengths




Actual length = 73 ft.

Total equivalent length = **278 ft.**
(With duct-board junctions = 418 ft.)

# Quality Construction: Air Conditioner Charges

- Refrigerant Charge & Airflow (RCA)
  - Tests for correct refrigerant charge and airflow.
- Thermostatic Expansion Valve (TXV)
  - Regulates flow of refrigerant into coil.

# Quality Construction: Duct Layout

- Reduced Duct Surface Area
  - Only in conjunction with ACCA D
- 12’ Outside Conditioned Space
- 100% Inside Conditioned Space

# Third Party Inspections

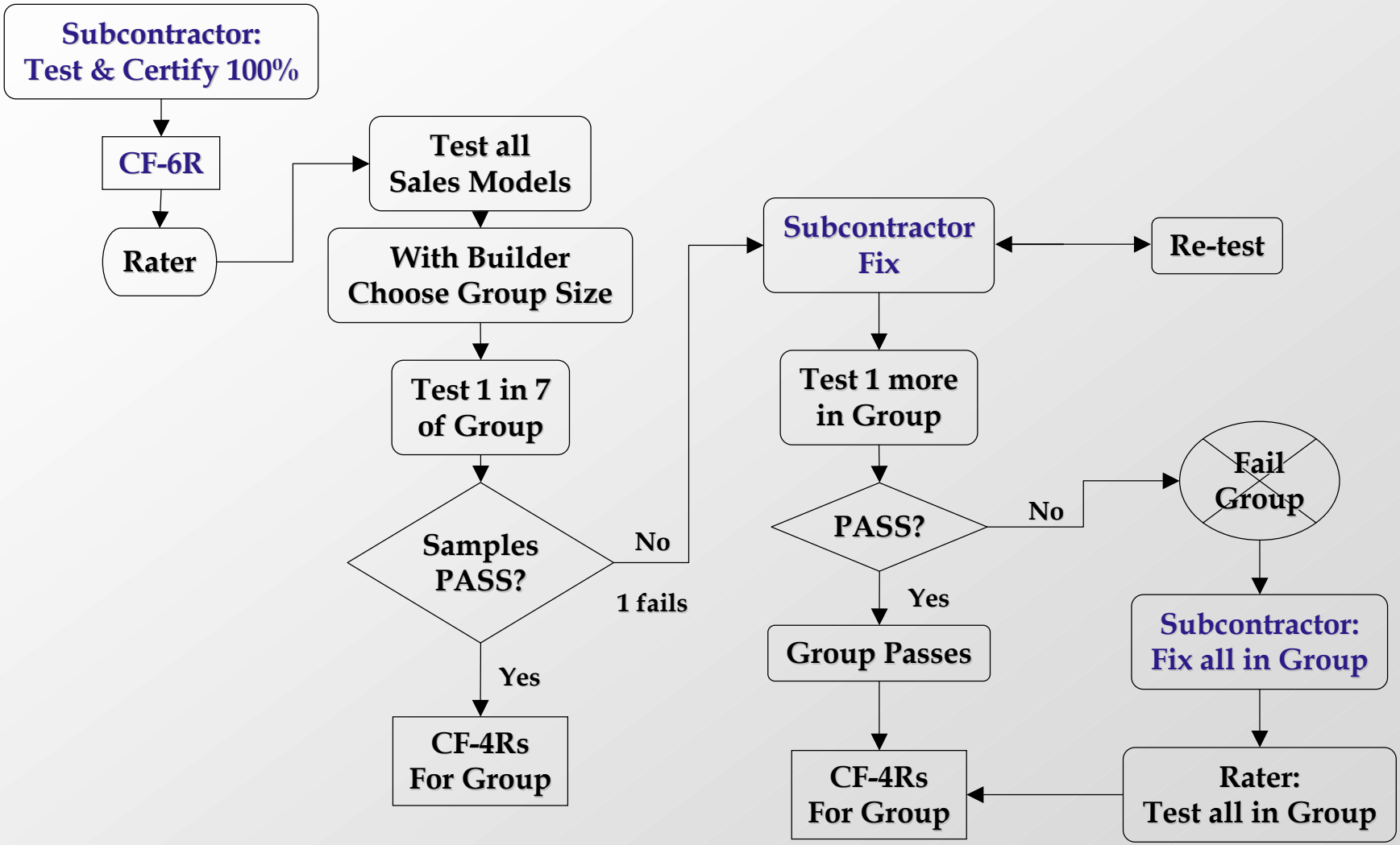
- Home Energy Rating
- CHEERS
- Installer Certification
- Sampling

# Verification and Diagnostic Testing

- **Diagnostic Testing AND Field Verification:**
  - Duct air sealing
  - ACCA Manual D design and installation
  - Building envelope sealing
  - Refrigerant charge and airflow measurement
- **Field Verification:**
  - Thermostatic expansion valves
  - Duct surface area reductions
  - Duct location improvements

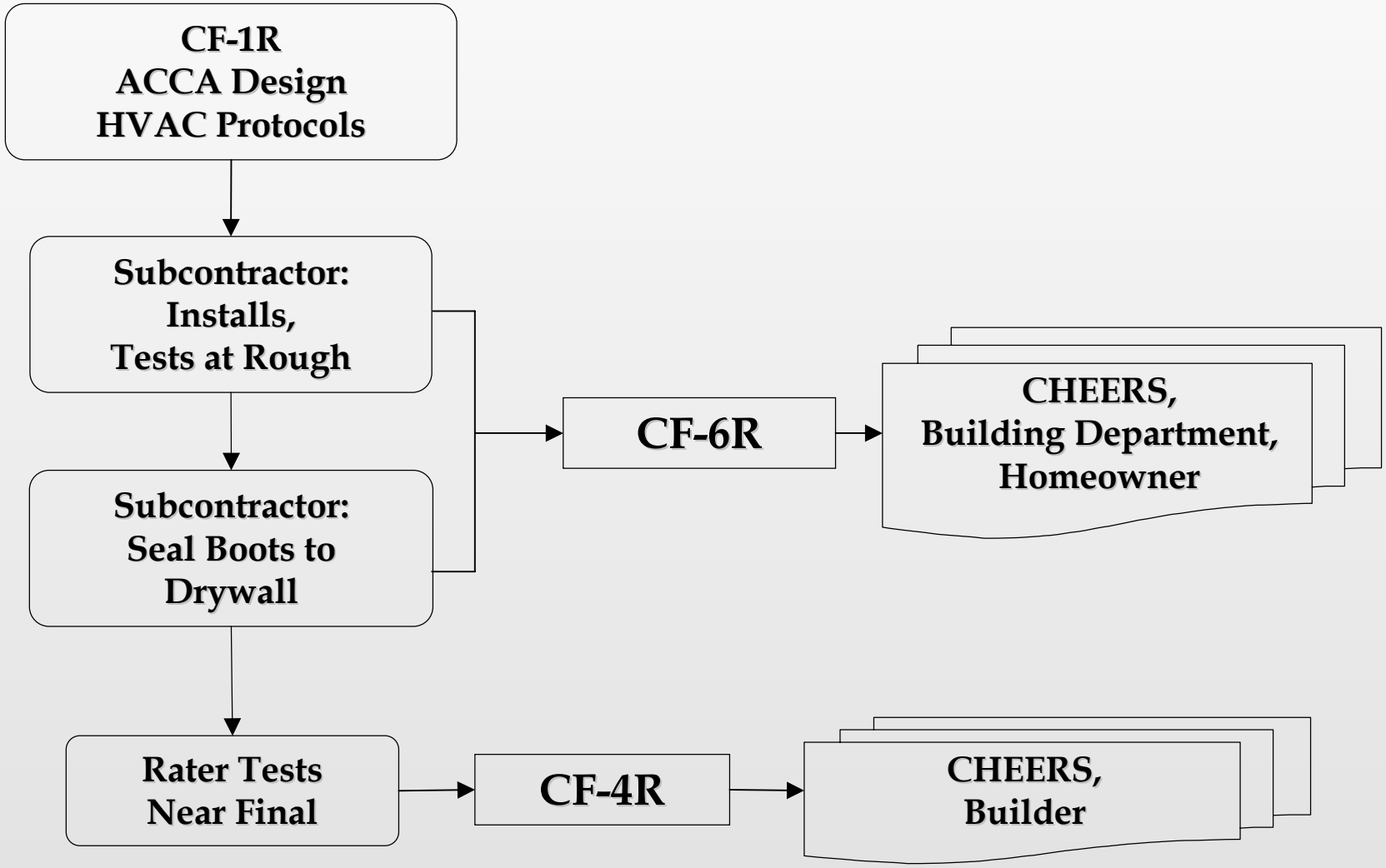
# Field Verification Procedures

## for Third Party Features



# Document Flow Sheet

## for Third Party Testing



# Water Heating

- Energy Factor
- Number of Water Heaters
- Size
- Input Rating
- External Blanket
- Pipe Insulation
- Recirculation Pump
- Controls

# CF-1R Example Page 1

```
==============================================================================
Project Title.......... Generic Project                 Date..01/15/02 11:39:52
Project Address........ PLAN #                  *******  ---------------------
                        CITY - CZ               *v6.01*  | _________________ |
Documentation Author... CM                      *******  | Building Permit # |
                        ConSol                           | _________________ |
                        7407 Tam O'Shanter Dr Ste 200    | Plan Check / Date |
                        Stockton, CA  95210              | _________________ |
                        209-474-8446                     | Field Check/ Date |
Climate Zone........... 12                               ---------------------
Compliance Method...... MICROPAS6 v6.01 for 2001 Standards by Enercomp, Inc.
==============================================================================
|     MICROPAS6 v6.01  File-EXAMPLE  Wth-CTZ12S92  Program-FORM CF-1R        |
|             User#-MP0105  User-ConSol  Run-Example Documentation           |
------------------------------------------------------------------------------
```

GENERAL INFORMATION

| | |
|---|---|
| Conditioned Floor Area..... | 2568 sf |
| Building Type..... | Single Family Detached |
| Construction Type ..... | New |
| Building Front Orientation. | Cardinal - N,E,S,W |
| Number of Dwelling Units... | 1 |
| Number of Stories..... | 2 |
| Floor Construction Type.... | Raised Floor |
| Glazing Percentage..... | 25.5 % of floor area |
| Average Glazing U-factor... | 0.4 Btu/hr-sf-F |
| Average Glazing SHGC..... | 0.41 |
| Average Ceiling Height..... | 12.1 ft |

BUILDING SHELL INSULATION

| Component Type | Frame Type | Cavity R-value | Sheathing R-value | Total R-value | Assembly U-factor | Location/Comments |
|---|---|---|---|---|---|---|
| Wall | Wood | R-13 | R-4.2 | R-17.2 | 0.062 | Front Wall, Left Wall Back Wall, Right Wall 225 Wall, 135 Wall 315 Wall |
| Door | Wood | R-0 | R-0 | R-0 | 0.330 | Entry Door |
| Floor | Wood | R-19 | R-n/a | R-19 | 0.037 | Subfloor |
| RoofRadiant | Wood | R-38 | R-n/a | R-38 | 0.028 | Flat W/ attic |
| RoofRadiant | Wood | R-19 | R-n/a | R-19 | 0.036 | Rafter Ceiling |

FENESTRATION

| Orientation | | Area (sf) | U-Factor | SHGC | Interior Shading | Exterior Shading | Over-hang/ Fins |
|---|---|---|---|---|---|---|---|
| Window | Front (N) | 16.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window | Front (N) | 4.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window | Front (N) | 16.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window | Front (N) | 4.0 | 0.330 | 0.360 | Standard | Standard | None |

# CF-1R Example Page 2

FENESTRATION

| Orientation | Area (sf) | U-Factor | SHGC | Interior Shading | Exterior Shading | Over-hang/ Fins |
|---|---|---|---|---|---|---|
| Window Right (NW) | 42.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Right (NW) | 20.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Right (NW) | 8.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Back (SW) | 8.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Back (SW) | 20.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Back (SW) | 42.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Left (E) | 20.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Left (E) | 5.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Right (NW) | 36.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Right (NW) | 24.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Back (SW) | 24.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Back (SW) | 36.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Left (E) | 9.0 | 0.330 | 0.360 | Standard | Standard | None |
| Door Back (S) | 40.0 | 0.850 | 0.700 | Standard | Standard | None |
| Window Back (S) | 6.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Left (SE) | 35.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Left (SE) | 10.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Back (SW) | 35.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Back (SW) | 10.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Back (S) | 9.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Back (S) | 20.0 | 0.330 | 0.360 | Standard | Standard | None |
| Door Back (S) | 40.0 | 0.850 | 0.700 | Standard | Standard | None |
| Window Back (S) | 15.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Left (SE) | 15.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Back (SW) | 15.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Right (W) | 16.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Right (W) | 15.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Right (W) | 15.0 | 0.330 | 0.360 | Standard | Standard | None |
| Window Right (W) | 5.0 | 0.330 | 0.360 | Standard | Standard | None |
| Skylight Front (N) | 8.0 | 0.940 | 0.730 | None | None | None |

HVAC SYSTEMS

| Equipment Type | Minimum Efficiency | Refrigerant Charge and Airflow | Duct Location | Duct R-value | Tested Duct Leakage | ACCA Manual D | Thermostat Type |
|---|---|---|---|---|---|---|---|
| Furnace | 0.900 AFUE | n/a | Attic | R-4.2 | Yes | No | Setback |
| ACSplitTXV | 12.00 SEER | Yes | Attic | R-4.2 | Yes | No | Setback |

DUCT TESTING DETAILS

| Equipment Type | Duct Leakage Target (% fan CFM/CFM25) | Measured Supply Duct Surface Area (ft2) |
|---|---|---|
| Furnace / ACSplitTXV | 6% / 107.9 | n/a |

INFILTRATION TESTING DETAILS

| Blower Door Leakage Target (CFM50h/SLA) | Blower Door Leakage Minimum (CFM50h/SLA) |
|---|---|
| 2555 / 3.8 | 1009 / 1.5 |

WATER HEATING SYSTEMS

| Tank Type | Heater Type | Distribution Type | Number in System | Energy Factor | Tank Size (gal) | External Insulation R-value |
|---|---|---|---|---|---|---|
| Storage | Gas | PipeInsulation | 1 | 0.60 | 50 | R- n/a |

SPECIAL FEATURES AND MODELING ASSUMPTIONS

*** Items in this section should be documented on the plans, ***
*** installed to manufacturer and CEC specifications, and ***
*** verified during plan check and field inspection. ***

This is a multiple orientation building with no orientation restrictions.
This printout is for the front facing North.

This building incorporates a Radiant Barrier. The radiant barrier must have an emissivity less than or equal to 0.05, must be installed to cover the roof trusses, rafters, gable end walls and other vertical attic surfaces, and must meet attic ventilation criteria.

This building incorporates Tested Duct Leakage.

This building incorporates Tested Infiltration.
The Homeowner's Manual must include instructions on how to operate the windows and/or mechanical ventilation to achieve adequate ventilation. In addition, this house is prohibited for having vented combustion appliances other than cooking appliances, refrigerators and domestic clothes dryers that use indoor air for combustion inside conditioned space.

This building incorporates either Tested Refrigerant Charge and Airflow (RCA) or a Thermostatic Expansion Valve (TXV) on the specified air conditioning system(s).

==========

HERS REQUIRED VERIFICATION
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```
*** Items in this section require field testing and/or      ***
*** verification by a certified home energy rater under     ***
*** the supervision of a CEC-approved HERS provider using   ***
*** CEC approved testing and/or verification methods and    ***
*** must be reported on the CF-6R installation certificate. ***
```

This building incorporates Tested Duct Leakage. Target CFM leakage values measured at 25 pascals are shown in DUCT TESTING DETAILS above or may be calculated as documented on the CF-6R. If the measured CFM is above the target, then corrective action must be taken to reduce the duct leakage and then must be retested. Alternatively, the compliance calculations could be redone without duct testing. If ducts are not installed, then HERS verification is not necessary for Tested Duct Leakage.

This building incorporates Tested Infiltration. Target and Minimum CFM values measured at 50 pascals are shown in INFILTRATION TESTING DETAILS above. If the measured CFM50h is above the target, then corrective action must be taken to reduce the infiltration and then retest. Alternatively, the compliance calculations could be redone without infiltration testing. If the measured CFM50h is below the minimum, then the building must meet Uniform Mechanical Code requirements for unusally tight construction and corrective action must be taken to either intentionally increase infiltration or provide for mechanical supply ventilation adequate to maintain the residence at a pressure greater than -5 pascals relative to the outside average air pressure with other continuous ventilation fans operating

This building incorporates either Tested Refrigerant Charge and Airflow (RCA) or a Thermostatic Expansion Valve (TXV) on the specified air conditioning system(s). If a cooling system is not installed, then HERS verification is not necessary for the RCA or TXV.

REMARKS
---

DUAL PANE, METAL FRAME WINDOWS WITH CLEAR GLASS
U-VALUES = 0.87 (SL) / 0.87 (SH) / 0.85 (FRENCH DOOR) / 0.72 (FX)
SHGC = 0.73 (FX) / 0.70 (FRENCH DOOR) / 0.70 (SL & SH)
SEE FENESTRATION DEFAULT U-VALUE & SHGC TABLE

_____
_____
_____

COMPLIANCE STATEMENT

This certificate of compliance lists the building features and performance specifications needed to comply with Title-24, Parts 1 and 6 of the California Code of Regulations, and the administrative regulations to implement them. This certificate has been signed by the individual with overall design responsibility. When this certificate of compliance is submitted for a single building plan to be built in multiple orientations, any shading feature that is varied is indicated in the Special Features Modeling Assumptions section.

| DESIGNER or OWNER | | DOCUMENTATION AUTHOR | |
|---|---|---|---|
| Name.... | _____ | Name.... | CM |
| Company. | BUILDER | Company. | ConSol |
| Address. | ADDRESS | Address. | 7407 Tam O'Shanter Dr Ste 200 |
| | CITY, ST | | Stockton, CA 95210 |
| Phone... | PHONE # | Phone... | 209-474-8446 |
| License. | _____ | | |
| Signed.. | _____ (date) | Signed.. | _____ (date) |

ENFORCEMENT AGENCY

Name.... _____
Title... _____
Agency.. _____
_____
Phone... _____

Signed.. _____
(date)

# Know your Consultant

- Years in Business?
- Who are Their Other Clients?
- Errors and Omissions Insurance?
- Have a Third Party Periodically Review.
- You are Responsible for Accuracy.

## INSTALLATION CERTIFICATE (Page 1 of 13) CF-6R

**Site Address** **Permit Number**

An installation certificate is required to be posted at the building site or made available for all appropriate inspections. (The information provided on this form is required; however, use of this form to provide the information is optional.) After completion of final inspection, a copy must be provided to the building department (upon request) and the building owner at occupancy, per Section 10-103(b).

**HVAC SYSTEMS:**

***Heating Equipment***

| Equip. Type (pkg. heat pump) | CEC Certified Mfr Name and Model Number | # of Identical Systems | Efficiency (AFUE, etc.)[1] [≥CF-1R value] | Duct Location (attic, etc.) | Duct or Piping R-value | Heating Load (Btu/hr) | Heating Capacity (Btu/hr) |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

***Cooling Equipment***

| Equip. Type (pkg. heat pump) | CEC Certified Compressor Unit Mfr Name and Model Number | # of Identical Systems | Efficiency (SEER, etc.)[1] [≥CF-1R value] | Duct Location (attic, etc.) | Duct R-value | Cooling Load (Btu/hr) | Cooling Capacity (Btu/hr) |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

1. ≥ reads *greater than or equal to.*

I, the undersigned, verify that equipment listed above is: 1) is the actual equipment installed, 2) equivalent to or more efficient than that specified in the certificate of compliance (Form CF-1R) submitted for compliance with the *Energy Efficiency Standards* for residential buildings, and 3) equipment that meets or exceeds the appropriate requirements for manufactured devices (from the *Appliance Efficiency Regulations* or Part 6), where applicable.

Signature, Date

Installing Subcontractor (Co. Name)
OR General Contractor (Co. Name) OR Owner

**WATER HEATING SYSTEMS:**

| Heater Type | CEC Certified Mfr Name & Model Number | Distribution Type (Std, Point-of-Use) | If Recir-culation, Control Type | # of Identical Systems | Rated[2] Input (kW or Btu/hr) | Tank Volume (gallons) | Effi-ciency[2] (EF, RE) | Standby[2] Loss (%) | External Insulation R-value[3] |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

2 For **small gas storage** (rated input of less than or equal to 75,000 Btu/hr), **electric resistance** and **heat pump water heaters**, list Energy Factor.
For **large gas storage water heaters** (rated input of greater than 75,000 Btu/hr), list Recovery Efficiency, Standby Loss and Rated Input.
For **instantaneous gas water heaters**, list Recovery Efficiency and Rated Input.
3. R-12 external insulation is mandatory for storage water heaters with an energy factor of less than 0.58.

**Faucets & Shower Heads:**
All faucets and showerheads installed are certified to the Commission, pursuant to Title 24, Part 6, Section 111.

I, the undersigned, verify that equipment listed above my signature is: 1) the actual equipment installed; 2) equivalent to or more efficient than that specified in the certificate of compliance (Form CF-1R) submitted for compliance with the *Energy Efficiency Standards* for residential buildings; and 3) equipment that meets or exceeds the appropriate requirements for manufactured devices (from the *Appliance Efficiency Regulations* or Part 6), where applicable.

Signature, Date

Installing Subcontractor (Co. Name) OR
General Contractor (Co. Name) OR Owner

COPY TO: Building Department
HERS Provider (if applicable)
Building Owner at Occupancy

# CF-6R Example Page 2

## INSTALLATION CERTIFICATE (Page 2 of 13) CF-6R

**Site Address** **Permit Number**

**FENESTRATION/GLAZING:**

| Manufacturer/Brand Name | Product U-Factor[1] (≤ CF-1R value)[2] | Product SHGC[1] (≤ CF-1R value)[2] | # of Panes | Total Quantity of Like Product *(Optional)* | Square Feet | Exterior Shading Device or Overhang | Comments/Location/ Special Features |
|---|---|---|---|---|---|---|---|
| (GROUP LIKE PRODUCTS) | | | | | | | |
| 1. | | | | | | | |
| 2. | | | | | | | |
| 3. | | | | | | | |
| 4. | | | | | | | |
| 5. | | | | | | | |
| 6. | | | | | | | |
| 7. | | | | | | | |
| 8. | | | | | | | |
| 9. | | | | | | | |
| 10. | | | | | | | |
| 11. | | | | | | | |
| 12. | | | | | | | |
| 13. | | | | | | | |
| 14. | | | | | | | |
| 15. | | | | | | | |

[1] Manufactured fenestration products use the values from the product label. Field fabricated fenestration products use the default values from Section 116 of the Energy Efficiency Standards.

[2] Installed U-Factor must be less than or equal to values from CF-1R. Installed SHGC must be less than or equal to values from CF-1R, or a shading device (exterior or overhang) is installed as specified on the CF-1R. Alternatively, installed weighted average U-Factors for the total fenestration area are less than or equal to values from CF-1R.

I, the undersigned, verify that the fenestration/glazing listed above my signature: 1) is the actual fenestration product installed; 2) is equivalent to or has a lower U-Factor and lower SHGC than that specified in the certificate of compliance (Form CF-1R) submitted for compliance with the *Energy Efficiency Standards* for residential buildings; and 3) the product meets or exceeds the appropriate requirements for manufactured devices (from Part 6), where applicable.

| Item #s (if applicable) | Signature, Date | Installing Subcontractor (Co. Name) OR General Contractor (Co. Name) OR Owner OR Window Distributor |
|---|---|---|
| Item #s (if applicable) | Signature, Date | Installing Subcontractor (Co. Name) OR General Contractor (Co. Name) OR Owner OR Window Distributor |
| Item #s (if applicable) | Signature, Date | Installing Subcontractor (Co. Name) OR General Contractor (Co. Name) OR Owner OR Window Distributor |

COPY TO: Building Department
HERS Provider (if applicable)
Building Owner at Occupancy

**INSTALLATION CERTIFICATE** (Page 3 of 13) **CF-6R**

**Site Address** **Permit Number**

## DUCT LEAKAGE AND DESIGN DIAGNOSTICS

☐ **DUCT LEAKAGE REDUCTION**

Pressurization Test Results (CFM @ 25 PA)

Test Leakage (CFM) _____

Fan Flow

If Fan Flow is Calculated as 400 cfm/ton x number of tons, or as 21.7 x Heating Capacity in Thousands of Btu/hr, enter calculated value here _____

If fan flow is measured, enter measured value here _____

Leakage Fraction = Test Leakage/(Measured or Calculated Fan Flow) = _____

Pass if leakage fraction ≤ 0.06 ☐ Pass ☐ Fail

☐ **For AEROSOL TYPE SEALANTS ONLY - The following diagnostic testing was completed:**

Duct Fan Pressurization at rough-in measured leakage (CFM)

CHECK AFTER FINISHING WALL:

☐ Yes ☐ No ☐ Pressure pan test or House pressurization test

☐ Yes ☐ No ☐ Visual Inspection of Duct Connections ☐ Pass ☐ Fail

☐ **THERMOSTATIC EXPANSION VALVE (TXV)**

☐ Yes ☐ No Thermostatic Expansion Valve is installed and Access is provided for inspection

Yes is a pass ☐ Pass ☐ Fail

☐ **DUCT DESIGN**

1. ☐ Yes ☐ No ACCA Manual D Design calculations have been completed, Duct Design is on the plans and duct installation matches plans.

2. ☐ Yes ☐ No TXV is installed or Fan flow has been verified. If no TXV, verified fan flow matches design from CF-1R.

Measured Fan Flow = _____

Yes for both 1 and 2 is a Pass ☐ Pass ☐ Fail

☐ I, the undersigned, verify that the above diagnostic test results and the work I performed associated with the test(s) is in conformance with the requirements for compliance credit. [The builder shall provide the HERS provider a copy of the CF-6R signed by the builder employees or sub-contractors certifying that diagnostic testing and installation meet the requirements for compliance credit.]

Tests Performed | Signature, Date | Installing Subcontractor (Co. Name) OR General Contractor (Co. Name)

COPY TO: Building Department
HERS Provider (if applicable)
Building Owner at Occupancy

**Site Address** **Permit Number**

## REFRIGERANT CHARGE AND AIRFLOW MEASUREMENT

Verification for Required Refrigerant Charge and Adequate Airflow for Split System Space Cooling Systems without Thermostatic Expansion Valves

Outdoor Unit Serial # _____
Outdoor Unit Make _____
Outdoor Unit Model _____
Cooling Capacity _____ Btu/hr
Date of Verification _____
Date of Refrigerant Gauge Calibration _____ (must be checked monthly)
Date of Thermocouple Calibration _____ (must be checked monthly)

Standard Charge and Airflow Measurement (outdoor air dry-bulb 55 °F and above):

Note: The system should be installed and charged in accordance with the manufacturer's specifications before starting this procedure.

Measured Temperatures
- Supply (evaporator leaving) air dry-bulb temperature (Tsupply, db) _____ °F
- Return (evaporator entering) air dry-bulb temperature (Treturn, db) _____ °F
- Return (evaporator entering) air wet-bulb temperature (Treturn, wb) _____ °F
- Evaporator saturation temperature (Tevaporator, sat) _____ °F
- Suction line temperature (Tsuction, db) _____ °F
- Condenser (entering) air dry-bulb temperature (Tcondenser, db) _____ °F

Superheat Charge Method Calculations for Refrigerant Charge
- Actual Superheat = Tsuction, db – Tevaporator, sat _____ °F
- Target Superheat (from Table 1) _____ °F
- Actual Superheat – Target Superheat _____ °F
  (System passes if between -5 and +5°F)

Temperature Split Method Calculations for Adequate Airflow
- Actual Temperature Split = T return, db - Tsupply, db _____ °F
- Target Temperature Split (from Table 2) _____ °F
- Actual Temperature Split - Target Temperature Split _____ °F
  (System passes if between -3°F and +3°F or, upon remeasurement, if between +3°F and -25°F)

Standard Charge and Airflow Measurement Summary:

System shall pass both refrigerant charge and adequate airflow calculation criteria from the same measurements. If corrective actions were taken, both criteria must be remeasured and recalculated

System Passes _____ yes or _____ no

Site Address Permit Number

## DUCT LOCATION AND AREA REDUCTION DIAGNOSTICS

☐ **DUCT IN CONDITIONED SPACE**

☐ Yes ☐ No Duct in conditioned space criteria matches CF-1R

Yes is a Pass ☐ Pass ☐ Fail

☐ **REDUCED DUCT SURFACE AREA**

Measured duct exterior surface area in the following unconditioned duct locations (square feet):

Attics _____

Crawlspaces _____

Basements _____

Other (e.g., garages, etc.) _____

☐ Yes ☐ No Duct surface area matches CF-1R?

Yes is a Pass ☐ Pass ☐ Fail

☐ I, the undersigned, verify that the duct surface area and duct locations claimed for duct surface area reductions and duct location improvements beyond those covered by default assumptions match those on the plans. [The builder shall provide the HERS provider a copy of the CF-6R signed by the builder employees or sub-contractors certifying that diagnostic testing and installation meet the requirements for compliance credit.]

Tests Performed | Signature, Date | Installing Subcontractor (Co. Name) OR General Contractor (Co. Name)

COPY TO: Building Department
HERS Provider (if applicable)
Building Owner at Occupancy

**INSTALLATION CERTIFICATE** (Page 10 of 13) **CF-6R**

**Site Address** **Permit Number**

## BUILDING ENVELOPE LEAKAGE DIAGNOSTICS

☐ **ENVELOPE SEALING INFILTRATION REDUCTION**

**Diagnostic Testing Results**

Building Envelope Leakage (CFM @ 50 Pa) as measured by Rater _____

1. ☐ Yes ☐ No Is measured envelope leakage less than or equal to the required level from CF-1R?
2. ☐ Yes ☐ No Is Mechanical Ventilation shown as required on the CF-1R?
   2a. ☐ Yes ☐ No If Mechanical Ventilation is required on the CF-1R (Yes in line 2), has it been installed?
   2b. ☐ Yes ☐ No Check this box yes if mechanical ventilation is required (Yes in line 2) and ventilation fan watts are no greater than shown on CF-1R.
   Measured Watts = _____
3. ☐ Yes ☐ No Check this box yes if measured building infiltration (CFM @ 50 Pa) is greater than the CFM @ 50 values shown for an SLA of 1.5 on CF-1R (If this box is checked no, mechanical ventilation is required.)
4. ☐ Yes ☐ No Check this box yes if measured building infiltration (CFM @ 50 Pa) is less than the CFM @ 50 values shown for an SLA of 1.5 on CF-1R, mechanical ventilation is installed and house pressure is greater than minus 5 Pascal with all exhaust fans operating.

☐ Pass ☐ Fail

Pass if:
d. Yes in line 1 and line 3, or
e. Yes in line 1 and line2, 2a, and 2b, or
f. Yes in line 1 and Yes in line 4.

Otherwise fail.

☐ I, the undersigned, verify that the building envelope leakage meets the requirements claimed for building leakage reduction below default assumptions as used for compliance on the CF-1R. This is to certify that the above diagnostic test results and the work I performed associated with the test(s) is in conformance with the requirements for compliance credit. [The builder shall provide the HERS provider a copy of the CF-6R signed by the builder employees or sub-contractors certifying that diagnostic testing and installation meet the requirements for compliance credit.]

Test Performed Signature Date Testing Subcontractor (Co. Name) OR General Contractor (Co. Name)

COPY TO: Building Department
HERS Provider (if applicable)
Building Owner at Occupancy

# Utility Incentives
# Preliminary Information

- New for 2002
  - State wide program for Investor Owned Utilities
  - 2 Incentives available for coastal CZ
  - 2 Incentives available for non-coastal CZ
  - Applications available
  - Limited funds available
  - Allocated by Utility

Look for the ENERGY STAR®

Note: For more information please leave your name & contact information on the evaluation sheet. Please reference Utility Incentives.

# Glossary

| | |
|---|---|
| C-2R | Computer method summary |
| CF-1R | Certificate of Compliance; summary of features required to comply to Title 24 (other than Mandatory Measures) |
| CF-6R | Installation certificate for<br>HVAC<br>Water Heating<br>Fenestration<br>Must meet requirements of CF-1R form and MF-1R features and be installed correctly |
| CF-4R | Field Verification: completed by HERS Rater; required for duct and air infiltration credits |
| IC-1 | Insulation Certificate |
| MF-1R | Mandatory Measures Features check list; can’t change |

# Training Resources

- California Energy Commission
  - www.energy.ca.gov
- The Building Industry Institute
  - www.thebii.org
- ConSol
  - www.consol.ws
- CHEERS
  - www.cheers.org
- NFRC
  - www.nfrc.org
- Air Conditioning Contractors of America (ACCA)
  - www.acca.org