

Builder Energy Code Training

Presented by:

The Building Industry Institute

and

ConSol

Sponsored by:



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%

Title 24

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

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

Gray Davis, Governor

CALIFORNIA
ENERGY
COMMISSION

COMMISSION APPROVED MANUAL

August 2001
P400-01-022

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



National Fenestration Rating Council

CERTIFIED

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

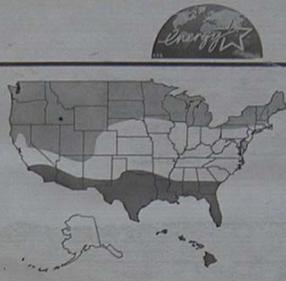
ENERGY Performance

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



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

Frenchwood® Hinged Patio Door tested to AAMA/NWDA 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 48

Temporary Labels

	QUALITY CONTROL & TESTING AAMA CERTIFICATION PROGRAM <small>ACCREDITED BY</small> AMERICAN NATIONAL STANDARDS INSTITUTE <small>A.L.A.S. INDICATOR MFG. ATM-1</small>	SERIES 480 AAMA / NWYDA 101 / I.S. 2-97 HS-R15-72x72	SECURITY TESTED <small>The manufacturer of this product maintains compliance with the forced entry resistance requirements of the California Model Building Security Ordinance.</small>	THIS PRODUCT HAS BEEN RATED IN ACCORDANCE WITH NFRC 100 033-003
---	---	---	--	--

Permanent Labels

CEC Default Label

	COMPANY NAME Address Phone
Product Line Material Series/Model Description	
Manufacturer certifies U-value rating determined in accordance with Residential Manufactured Fenestration Product Default Table	
Residential U-Value	Residential SHGC
0.72	0.73
This fenestration product has been certified by the manufacturer to meet the air infiltration requirements of Section 116(a)1., 1992 California Energy Standards.	

Must state
U-value is
derived
from
Default Table

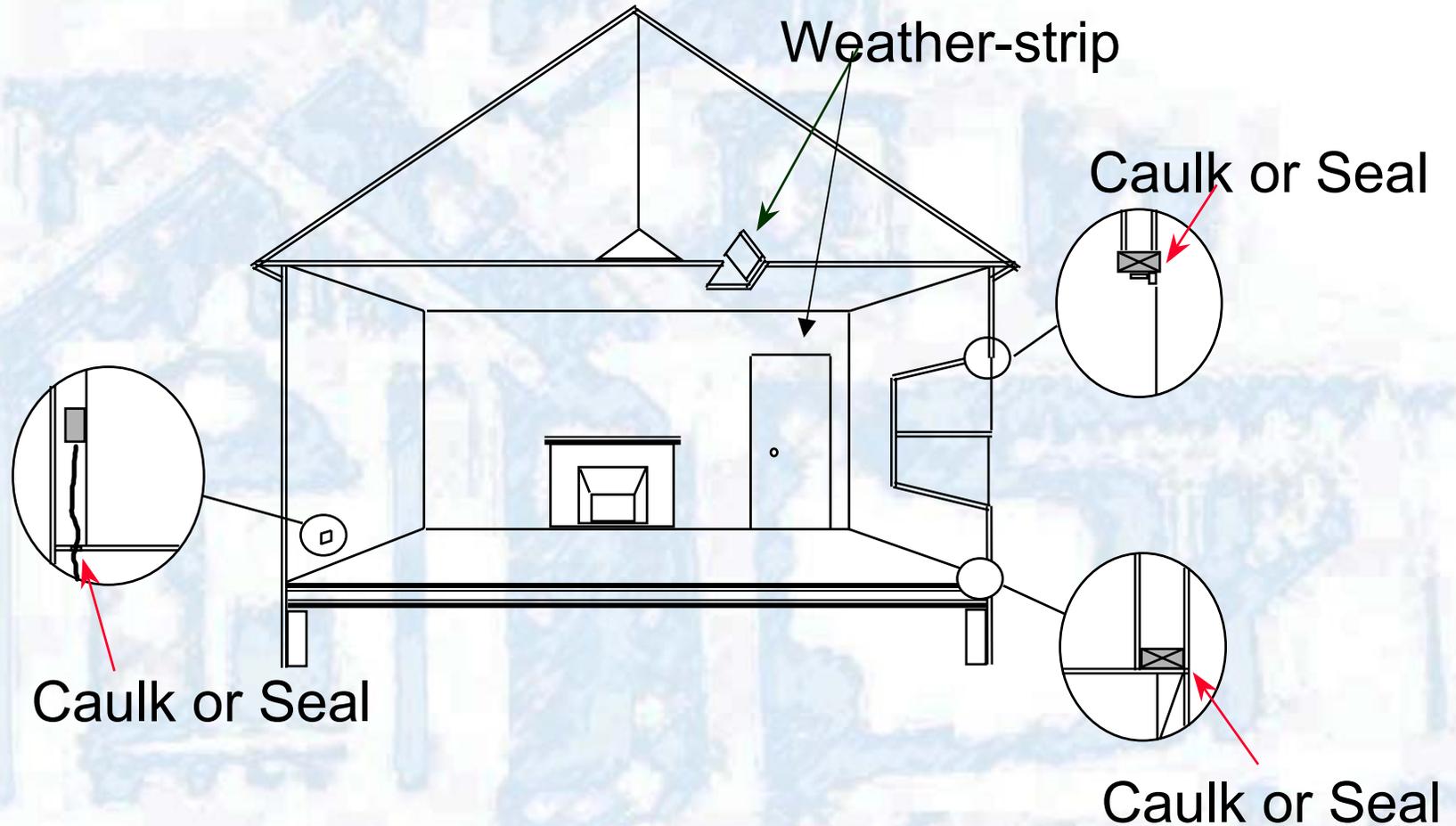
Must include
infiltration
statement

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

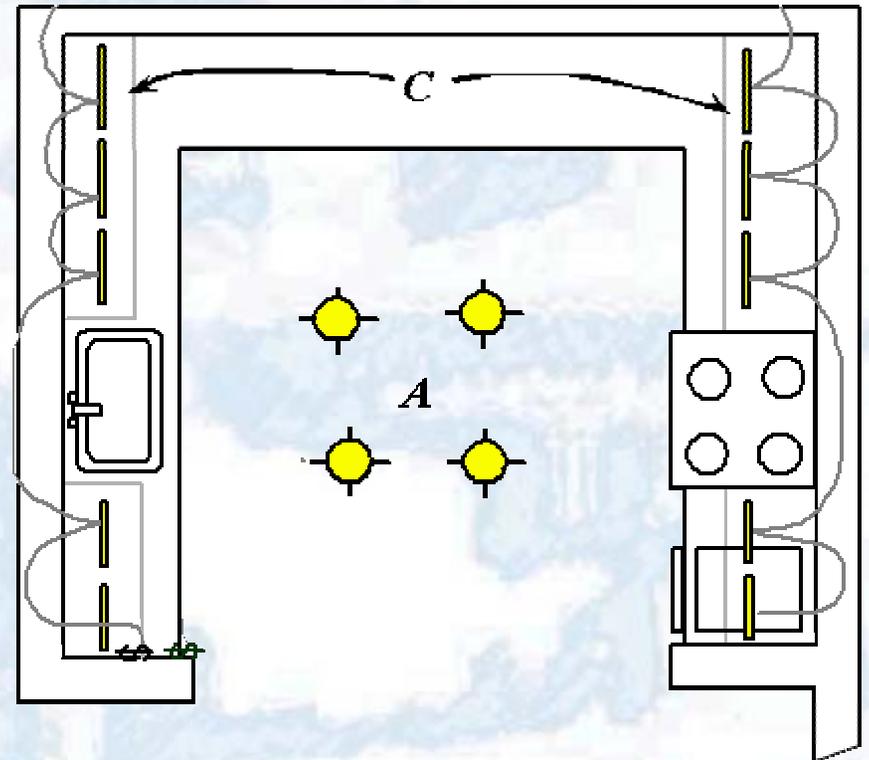
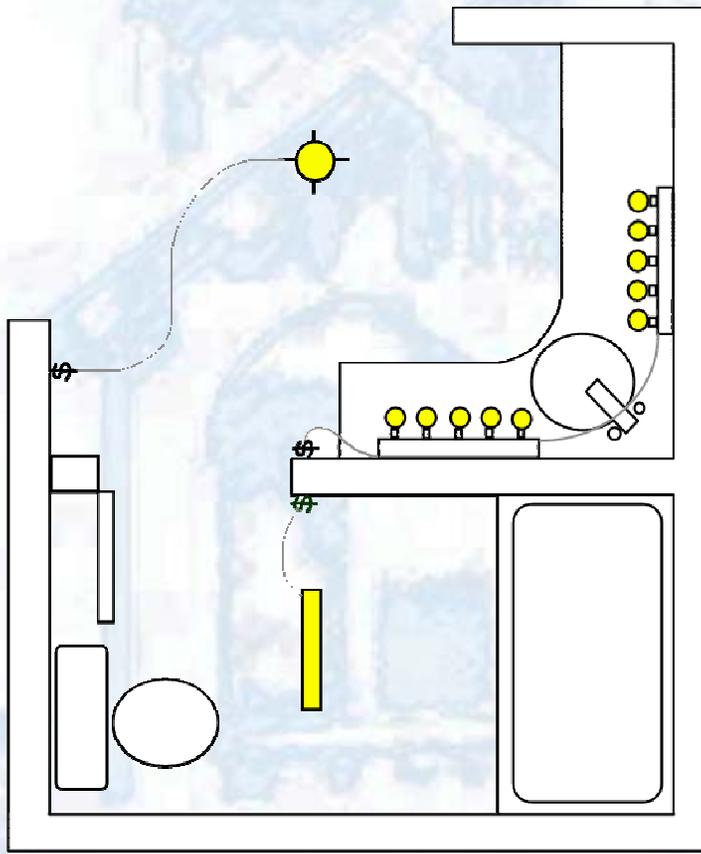
Mandatory Measures

- 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	R38	R38	R38	R38	R38	R38								
Walls	R21	R13	R19	R19	R19	R21	R21	R21								
“Heavy mass” walls	R4.76	R2.44	R4.76	R4.76	R4.76	R4.76	R4.76	R4.76								
Below-grade walls	R0	R13														
Slab floor perimeter	NR	R7														
Raised floors	R19															
Concrete raised floors	R8	R8	R0	R8	R4	R8	R8	R4	R8							
Radiant Barrier	NR	REQ	NR	REQ	NR	NR	NR	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*	NR							
SPACE CONDITIONING DUCTS																
Duct Sealing	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)

Ceiling	R-38
Walls	R-21
Raised Floors	R-19
Radiant Barrier	Req

(Space Heating)

Electric-resistant allowed	No
If gas, AFUE =	Min
If heat pump, Split HSPF	Min
If heat pump, Package HSPF	Min

(Glazing Maximums)

Total Area	16%
U-Factor	0.65
SHGC	NR

(Space Cooling)

If split, SEER =	Min
If package, SEER =	Min
RCA or TXV	NR

(Space Conditioning Ducts)

Duct Sealing Req*

*Alternative Package Available

Prescriptive Package D

Climate Zone 2

(Insulation Minimums)

Ceiling	R-30
Walls	R-13
Raised Floors	R-19
Radiant Barrier	NR

(Space Heating)

Electric-resistant allowed	No
If gas, AFUE =	Min
If heat pump, Split HSPF	Min
If heat pump, Package HSPF	Min

(Glazing Maximums)

Total Area	16%
U-Factor	0.65
SHGC	0.40

(Space Cooling)

If split, SEER =	Min
If package, SEER =	Min
RCA or TXV	Req*

(Space Conditioning Ducts)

Duct Sealing Req*

*Alternative Package Available

Prescriptive Package D

Climate Zone 3, 6

(Insulation Minimums)

Ceiling	R-30
Walls	R-13
Raised Floors	R-19
Radiant Barrier	NR

(Space Heating)

Electric-resistant allowed	No
If gas, AFUE =	Min
If heat pump, Split HSPF	Min
If heat pump, Package HSPF	Min

(Glazing Maximums)

Total Area	20%
U-Factor	0.75
SHGC	NR

(Space Cooling)

If split, SEER =	Min
If package, SEER =	Min
RCA or TXV	NR

(Space Conditioning Ducts)

Duct Sealing Req*

*Alternative Package Available

Prescriptive Package D

Climate Zone 4

(Insulation Minimums)

Ceiling	R-30
Walls	R-13
Raised Floors	R-19
Radiant Barrier	Req

(Space Heating)

Electric-resistant allowed	No
If gas, AFUE =	Min
If heat pump, Split HSPF	Min
If heat pump, Package HSPF	Min

(Glazing Maximums)

Total Area	20%
U-Factor	0.75
SHGC	0.40

(Space Cooling)

If split, SEER =	Min
If package, SEER =	Min
RCA or TXV	NR

(Space Conditioning Ducts)

Duct Sealing Req*

*Alternative Package Available

Prescriptive Package D

Climate Zone 5

(Insulation Minimums)

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

(Space Heating)

(Glazing Maximums)

Total Area	16%	If split, SEER =	Min
U-Factor	0.75	If package, SEER =	Min
SHGC	NR	RCA or TXV	NR

(Space Cooling)

(Space Conditioning Ducts)

Duct Sealing Req*

*Alternative Package Available

Prescriptive Package D

Climate Zone 7

(Insulation Minimums)

Ceiling	R-30
Walls	R-13
Raised Floors	R-19
Radiant Barrier	NR

(Space Heating)

Electric-resistant allowed	No
If gas, AFUE =	Min
If heat pump, Split HSPF	Min
If heat pump, Package HSPF	Min

(Glazing Maximums)

Total Area	20%
U-Factor	0.75
SHGC	0.40

(Space Cooling)

If split, SEER =	Min
If package, SEER =	Min
RCA or TXV	NR

(Space Conditioning Ducts)

Duct Sealing Req*

*Alternative Package Available

Prescriptive Package D

Climate Zone 8, 9

(Insulation Minimums)

Ceiling	R-30
Walls	R-13
Raised Floors	R-19
Radiant Barrier	Req*

(Space Heating)

Electric-resistant allowed	No
If gas, AFUE =	Min
If heat pump, Split HSPF	Min
If heat pump, Package HSPF	Min

(Glazing Maximums)

Total Area	20%
U-Factor	0.75
SHGC	0.40

(Space Cooling)

If split, SEER =	Min
If package, SEER =	Min
RCA or TXV	Req*

(Space Conditioning Ducts)

Duct Sealing Req*

*Alternative Package Available

Prescriptive Package D

Climate Zone 10

(Insulation Minimums)

Ceiling	R-30
Walls	R-13
Raised Floors	R-19
Radiant Barrier	Req*

(Space Heating)

Electric-resistant allowed	No
If gas, AFUE =	Min
If heat pump, Split HSPF	Min
If heat pump, Package HSPF	Min

(Glazing Maximums)

Total Area	20%
U-Factor	0.65
SHGC	0.40

(Space Cooling)

If split, SEER =	Min
If package, SEER =	Min
RCA or TXV	Req*

(Space Conditioning Ducts)

Duct Sealing Req*

*Alternative Package Available

Prescriptive Package D

Climate Zone 11, 12, 13

(Insulation Minimums)

Ceiling	R-38
Walls	R-19
Raised Floors	R-19
Radiant Barrier	Req*

(Space Heating)

Electric-resistant allowed	No
If gas, AFUE =	Min
If heat pump, Split HSPF	Min
If heat pump, Package HSPF	Min

(Glazing Maximums)

Total Area	16%
U-Factor	0.65
SHGC	0.40

(Space Cooling)

If split, SEER =	Min
If package, SEER =	Min
RCA or TXV	Req*

(Space Conditioning Ducts)

Duct Sealing Req*

*Alternative Package Available

Prescriptive Package D

Climate Zone 16

(Insulation Minimums)

Ceiling	R-38
Walls	R-19
Raised Floors	R-19
Radiant Barrier	NR
Slab Perimeter	R-7

(Space Heating)

Electric-resistant allowed	No
If gas, AFUE =	Min
If heat pump, Split HSPF	Min
If heat pump, Package HSPF	Min

(Glazing Maximums)

Total Area	16%
U-Factor	0.60
SHGC	NR

(Space Cooling)

If split, SEER =	Min
If package, SEER =	Min
RCA or TXV	NR

(Space Conditioning Ducts)

Duct Sealing Req*

*Alternative Package Available

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

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=====
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.
=====
  
```

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|          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 (kBtu/sf-yr)	Standard Design	Proposed Design	Compliance 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.

<u>Standard</u> <u>R-Value</u>	<u>Nominal</u> <u>Lumber Size</u>	<u>Actual</u> <u>Cavity Depth</u>	<u>Installed</u> <u>R-Value</u>
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



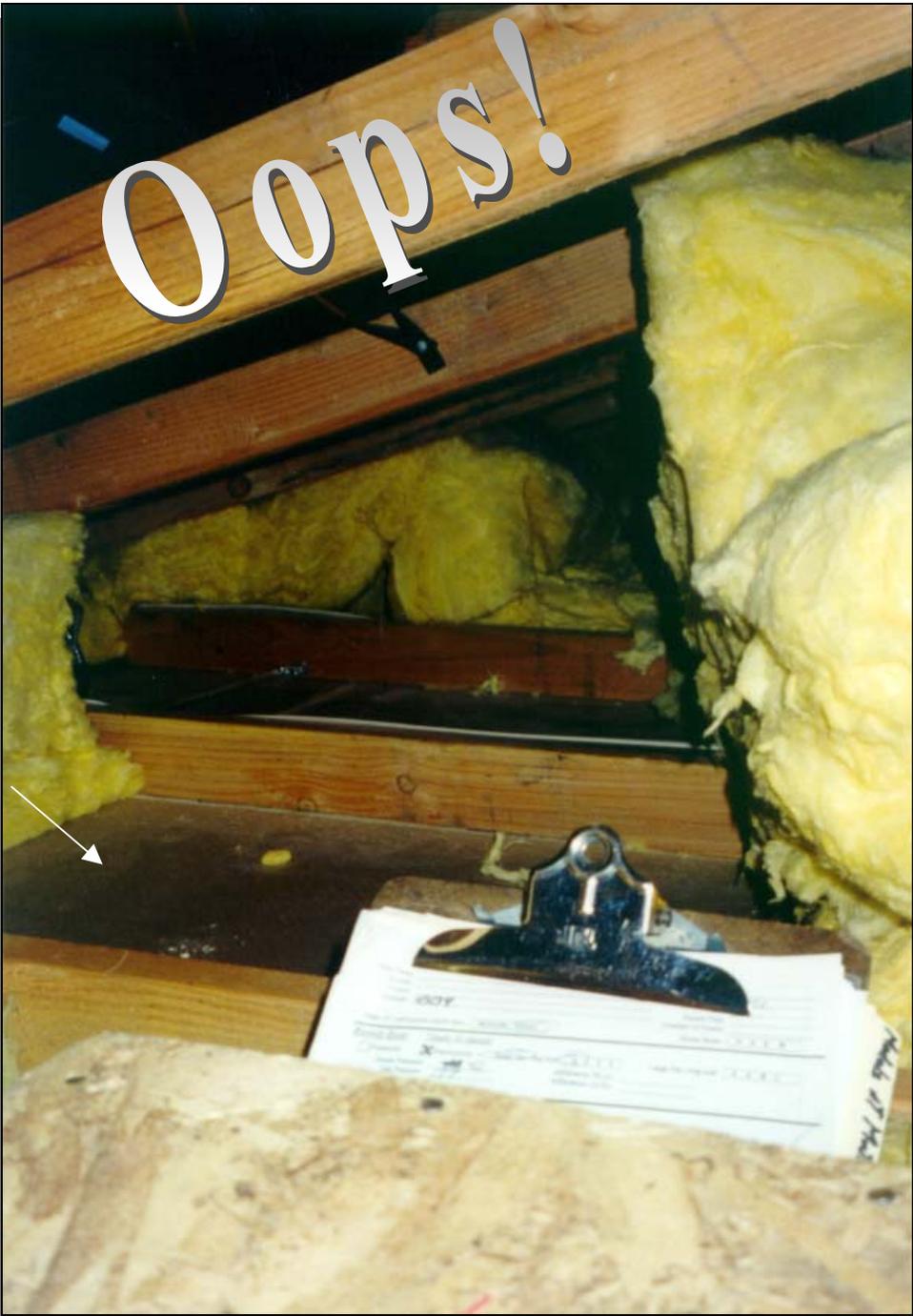


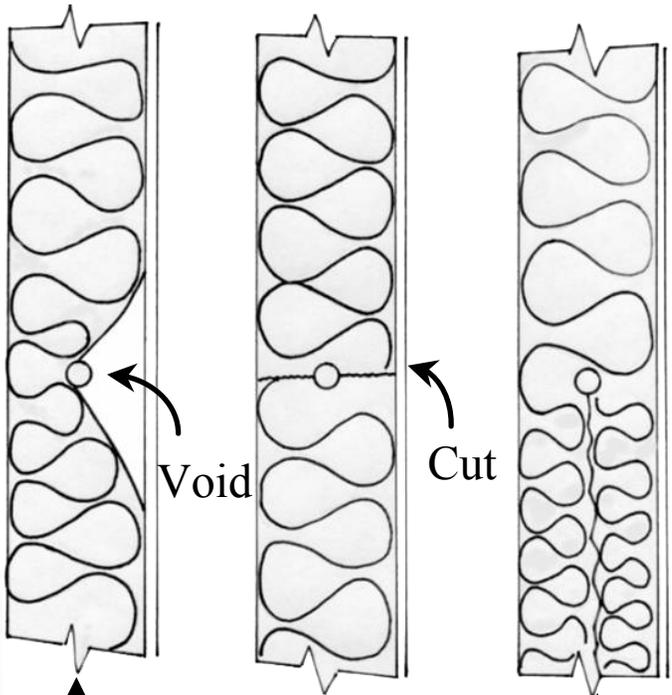
Compression



Batts cut incorrectly

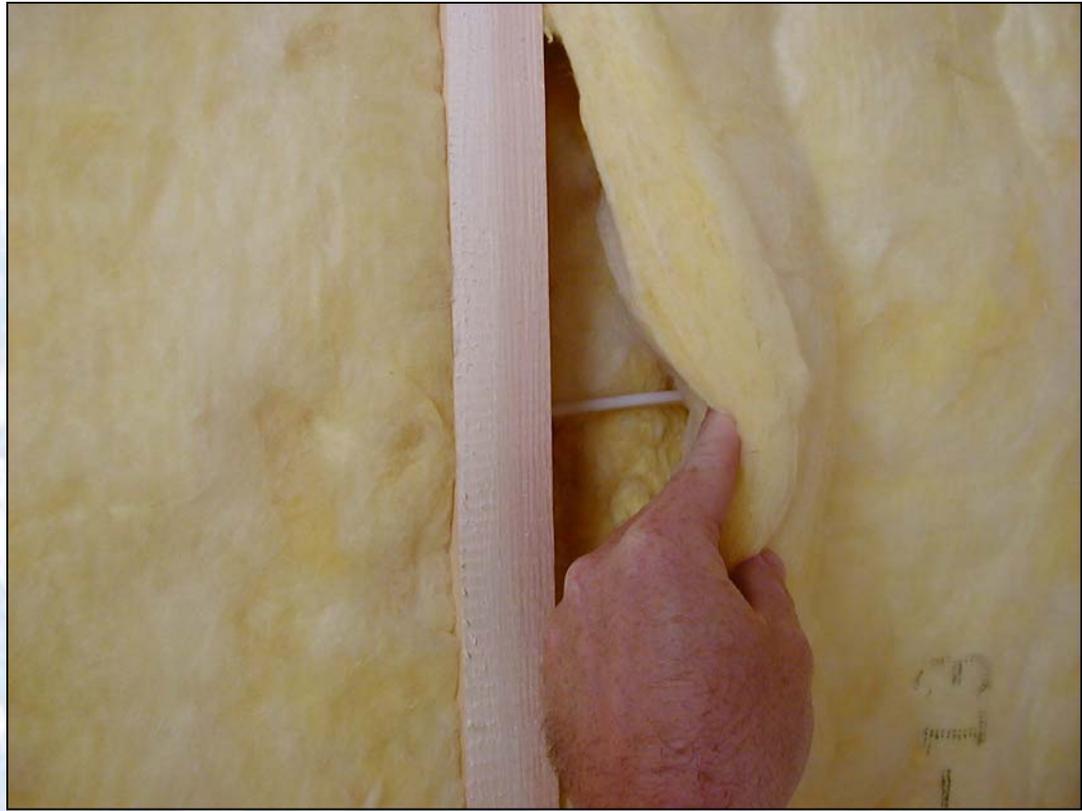
Oops!





Poor
Quality

Split:
BEST
QUALITY



Quality Installation

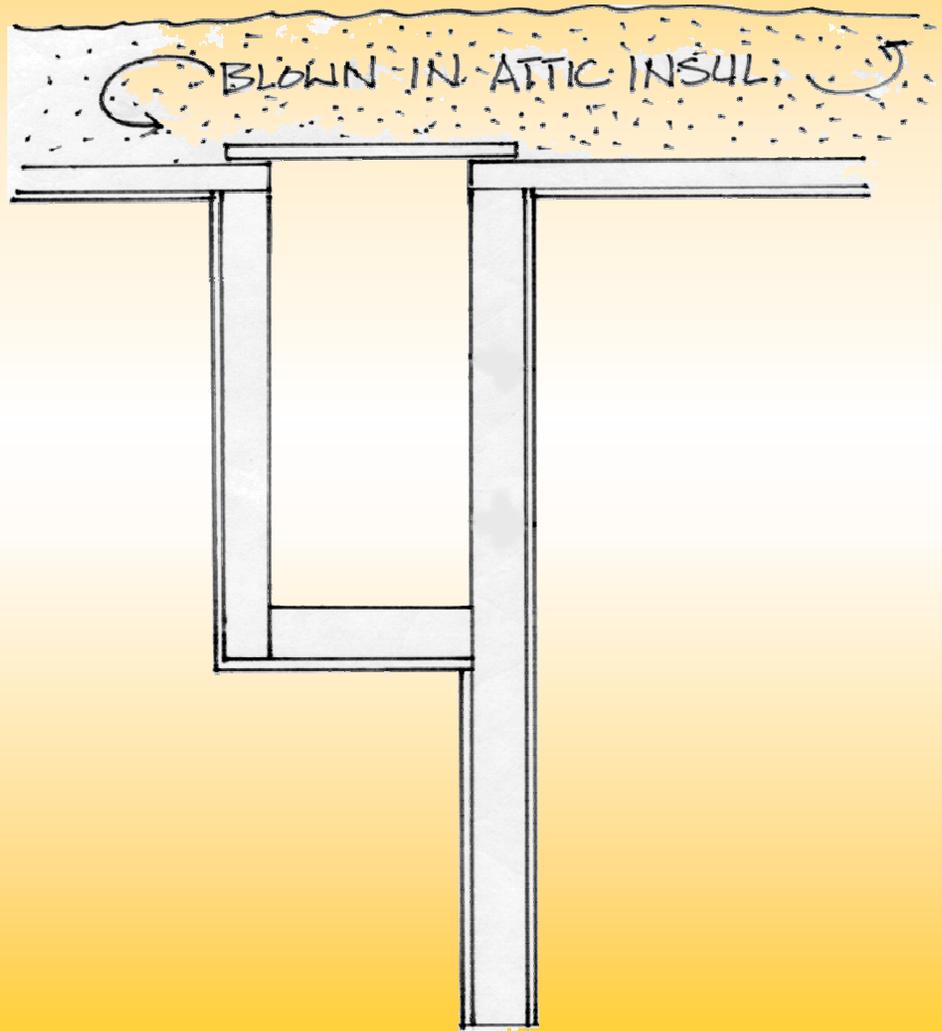
Uninsulated Channels & Corners



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

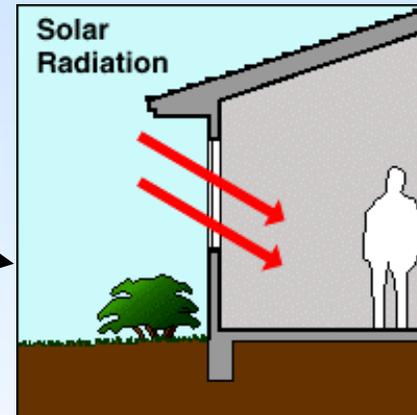
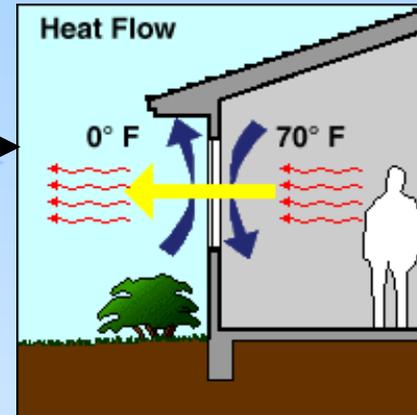


Quality Construction: Infiltration & Ventilation

- 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.

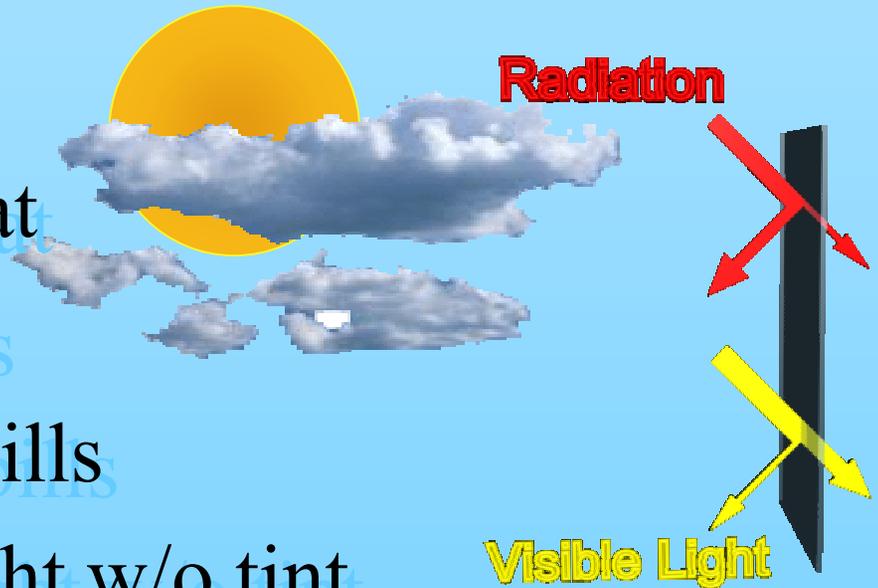
Flexible Features: Fenestration

- 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

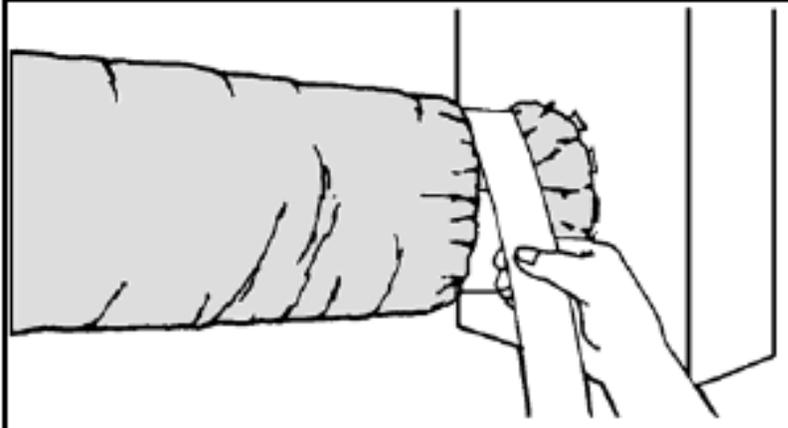
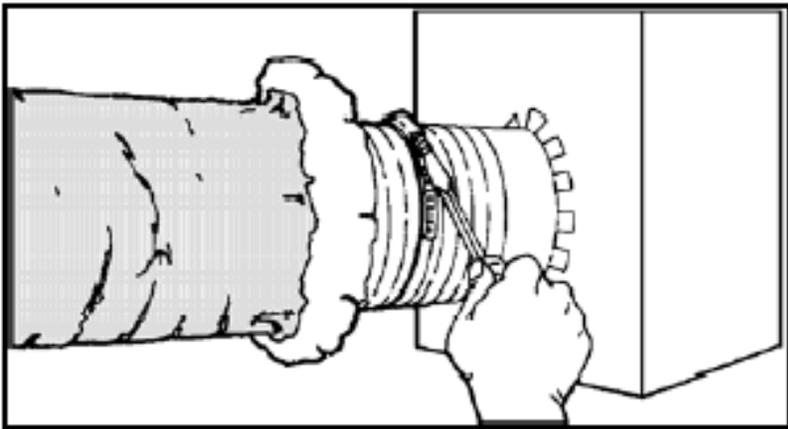
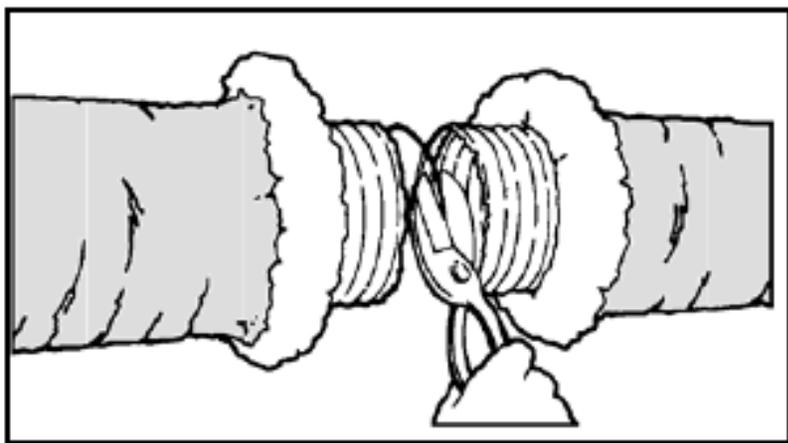
Increased Efficiency

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

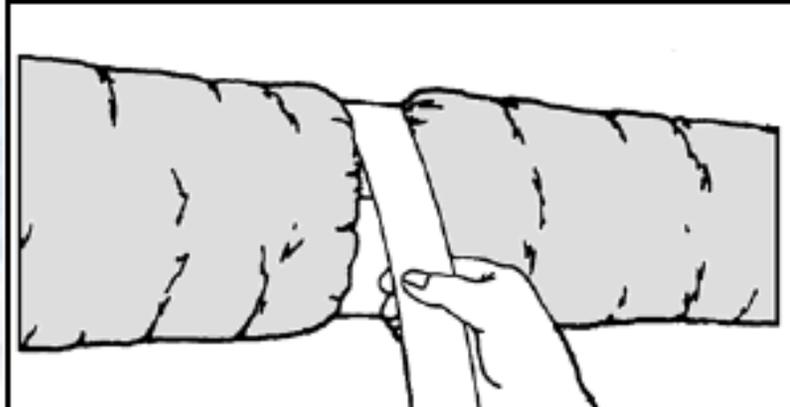
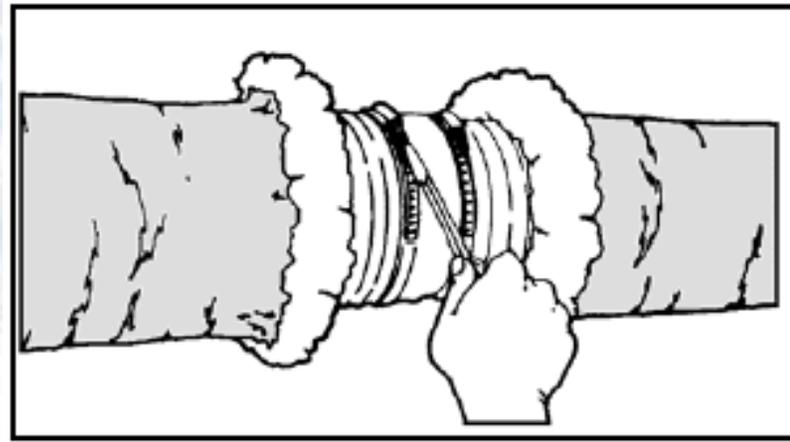
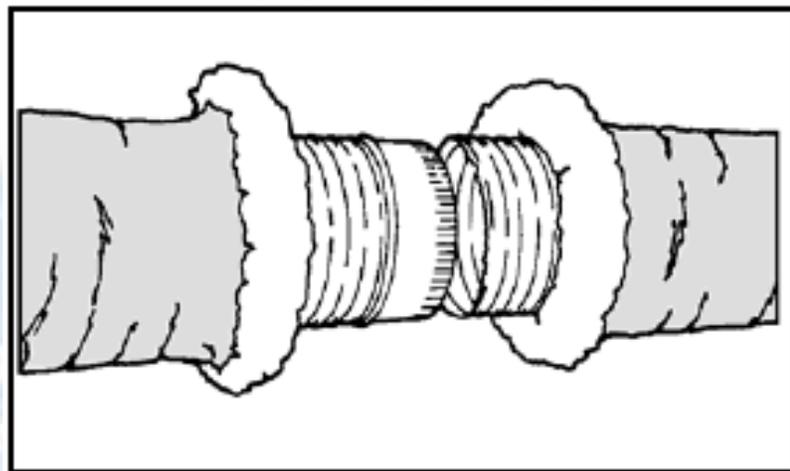
Quality Construction: Sealed Ducts

- 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

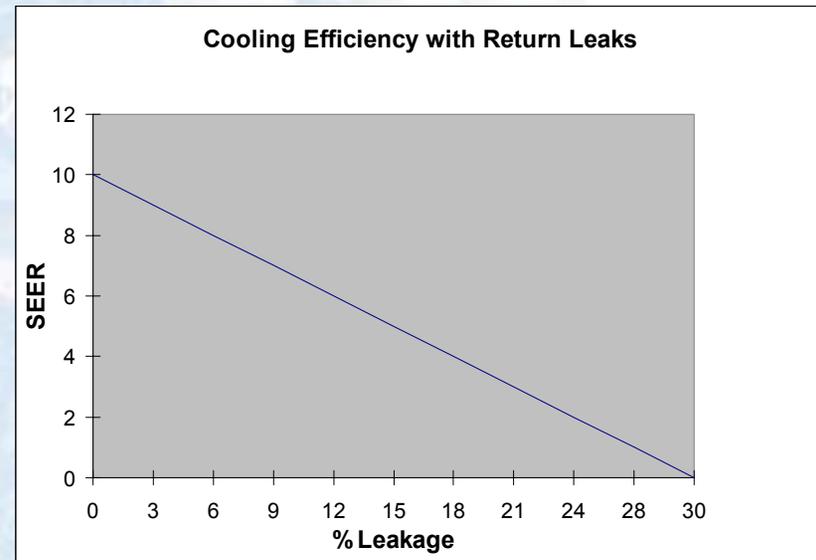
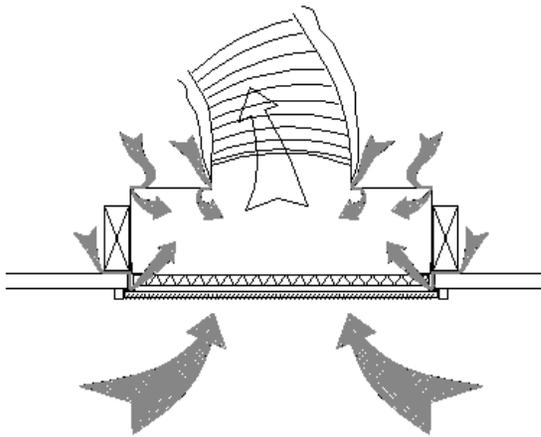


Duct to Duct



Return Air Leakage

Field Fabricated Return



At 120 deg Attic Temp.

Butterfly Collar





Mastic

Zip Tie

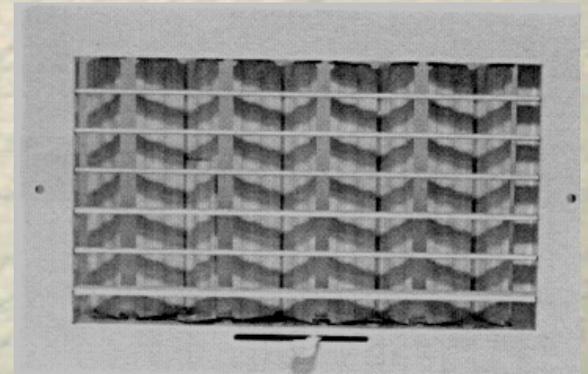
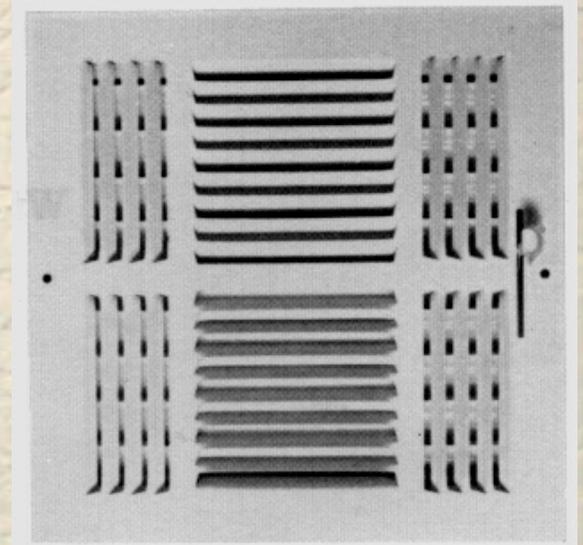


Quality Construction: ACCA HVAC Design

- 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



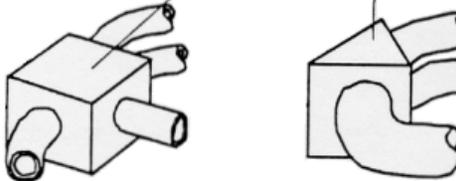
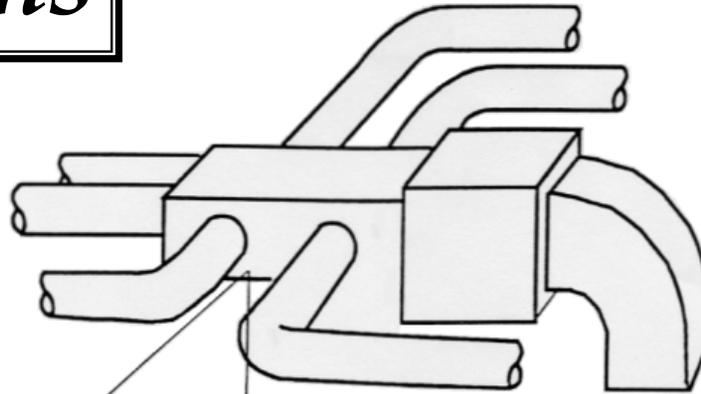
Equivalent Lengths

Group 11

Flexible Duct Junction Boxes and Radius Bends

Reference Velocity = As Indicated

Reference Friction Rate = 0.08 in. Wg. Per 100 Feet

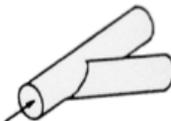
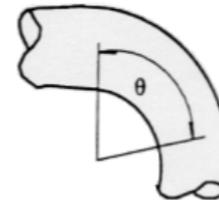


Velocity In Duct	EL Values	
	Junction Box	90° Bend
400	35	5
500	50	7
600	75	10
700	100	15
800	125	20
900	150	25

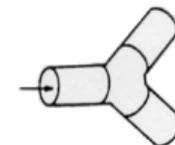
For bends that are not equal to 90°, multiply the 90 equivalent length by the ratio of the desired angle to the 90 angle.

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

$$15 \times 45 / 90 = 7.5 \text{ ft}$$



	EL
Branch	25
Main	5



EL = 15

Tight Strap





Restrictive Bend



Quality Installation



Pinched Return



Effective Opening

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

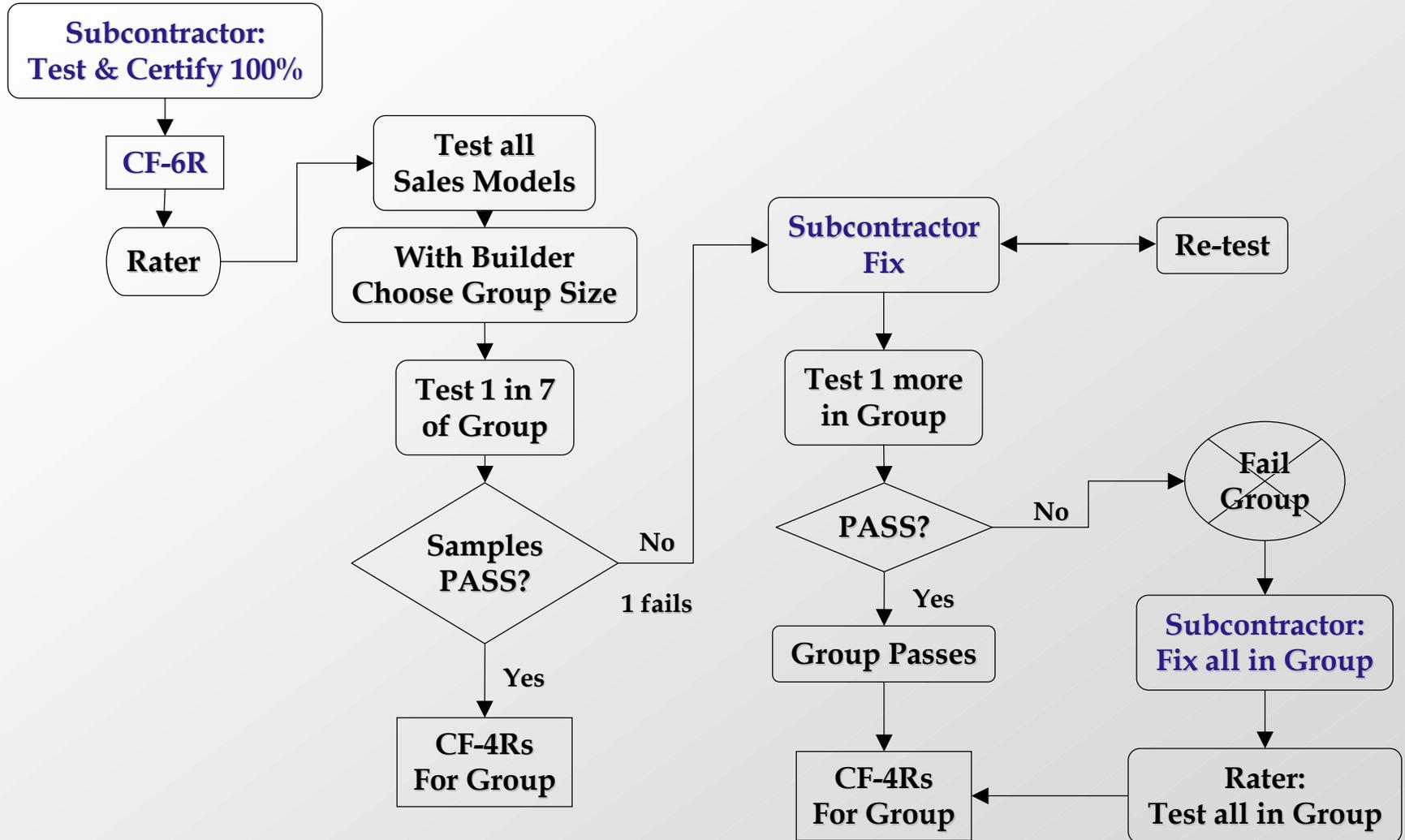


Verification and Diagnostic Testing

- **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

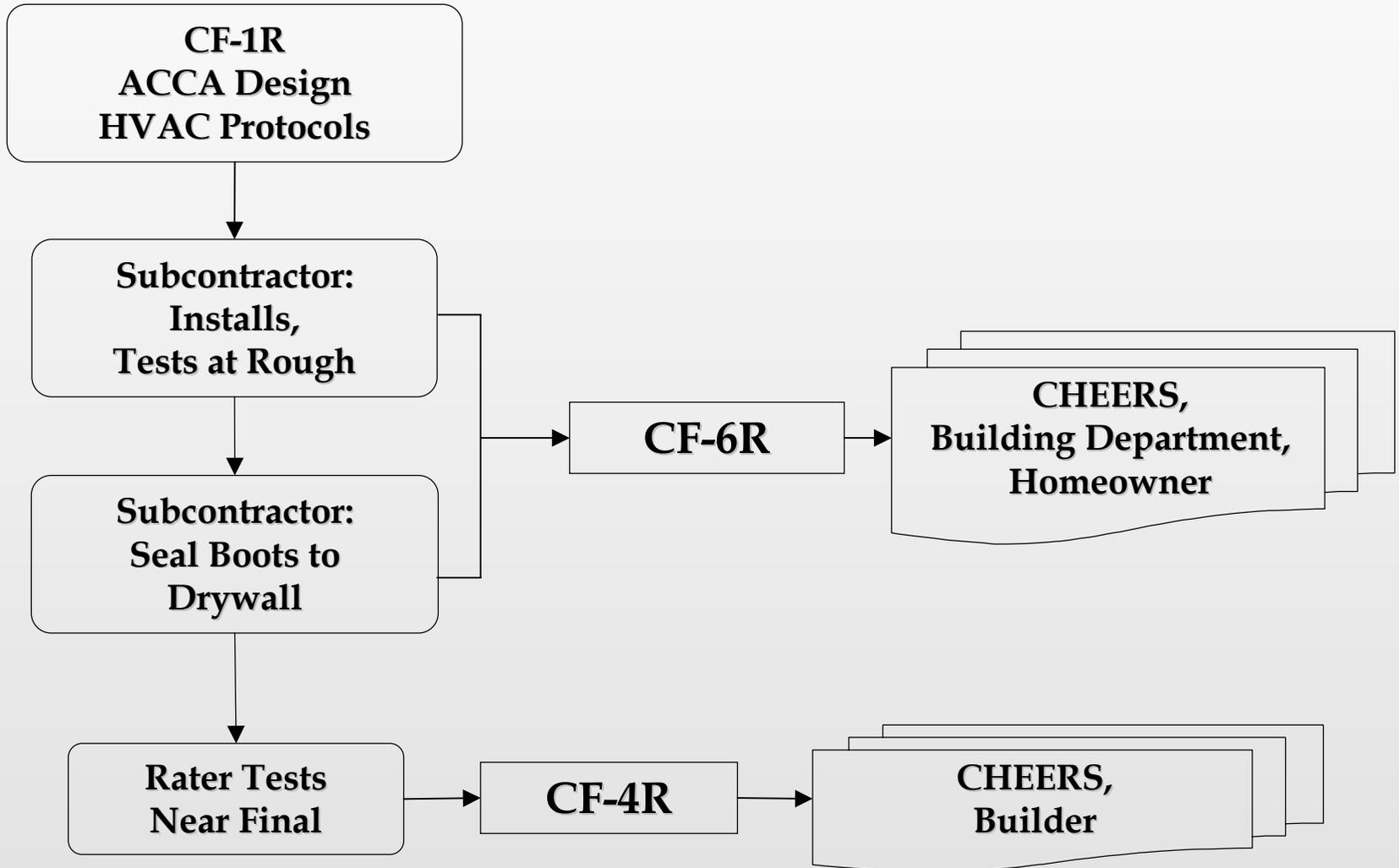
Field Verification Procedures

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

```

=====
Project Title..... Generic Project                      Date..01/15/02 11:39:52
Project Address..... PLAN #                            *****
                  CITY - CZ                            *v6.01*
Documentation Author... CM                             *****
                  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	Overhang/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

FENESTRATION

Orientation		Area (sf)	U-Factor	SHGC	Interior Shading	Exterior Shading	Overhang/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		Duct Location	Duct R-value	Tested Duct Leakage	ACCA Manual D	Thermostat Type
		Charge and Airflow	Duct					
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

*** 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 unusually 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

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 [\geq 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 [\geq CF-1R value]	Duct Location (attic, etc.)	Duct R-value	Cooling Load (Btu/hr)	Cooling Capacity (Btu/hr)

1. \geq reads *greater than or equal to*.

I, the undersigned, verify that equipment listed above 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 _____

WATER HEATING SYSTEMS:

Heater Type	CEC Certified Mfr Name & Model Number	Distribution Type (Std. Point-of-Use)	If Recirculation, Control Type	# of Identical Systems	Rated ² Input (kW or Btu/hr)	Tank Volume (gallons)	Efficiency 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

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
<i>(GROUP LIKE PRODUCTS)</i>							
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 \leq 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
COPY TO: Building Department
HERS Provider (if applicable)
Building Owner at Occupancy

Signature, Date _____

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

INSTALLATION CERTIFICATE

(Page 4 of 13)

CF-6R

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 = Treturn, 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

INSTALLATION CERTIFICATE

(Page 9 of 13)

CF-6R

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.]

Signature, Date

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

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



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



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
HVAC
Water Heating
Fenestration
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
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