

# **ENERGY STAR Qualified Homes: HVAC Quality Installation**

**Wes Davis**

Director, Quality Assured Program  
Air Conditioning Contractors of America



# The Air Conditioning Contractors of America (ACCA)

The only nationwide association representing the technical, educational and policy interests of U.S. businesses that design, install and maintain indoor environmental systems

# Antecedents

- National Warm Air Heating and Air Conditioning Assn. (1914)
- Air Conditioning and Refrigeration Contractors of America (1946)
- National Environmental Systems Contractors Assn. (1968)
- Air Conditioning Contractors of America (1969)

# Mission Statement

“To assist and enable  
HVACR contractors  
to acquire, serve and  
satisfy their customers.”

# Approach

- Contractor Support
- Consumer Assistance
- Government Relations
- Industry Relations
- Technical Expertise

# Membership

- About 5,000 Members
- In all 50 States and 12 foreign countries
- 43 Chapters across America

# ACCA QA Program

- QA Program Introduction:
  - History with ENERGY STAR
  - QA Program
- Rater validation elements

# ENERGY STAR v.3

- ENERGY STAR adopts ACCA 5 QI Standard ([www.acca.org/quality](http://www.acca.org/quality))
- Checklist development
- HVAC QI Training and Oversight (HQITO) organization
  - Train HVAC Contractors
  - Certify / Accredit HVAC Contractors
- Market driven approach





# Quality Installations Elements

## Design Aspects

- Ventilation
- Load Calc
- Equip Capacity Selection
- Geothermal HP Ground Heat Exchanger
- Matched Systems (ARHI)

## Installation Aspects

- Flow through Heat Exchanger (Air or Water)
- Refrigerant Charge
- Electrical Requirements
- On-rate (fuel-fired)
- Venting
- System Controls

## Distribution Aspects

- Duct Leakage
- Flow Balance (Air or Water)

## Doc. / Education Aspects

- System Documentation
- Owner Education

***Well recognized practices that quality contractors embrace when delivering quality installations***

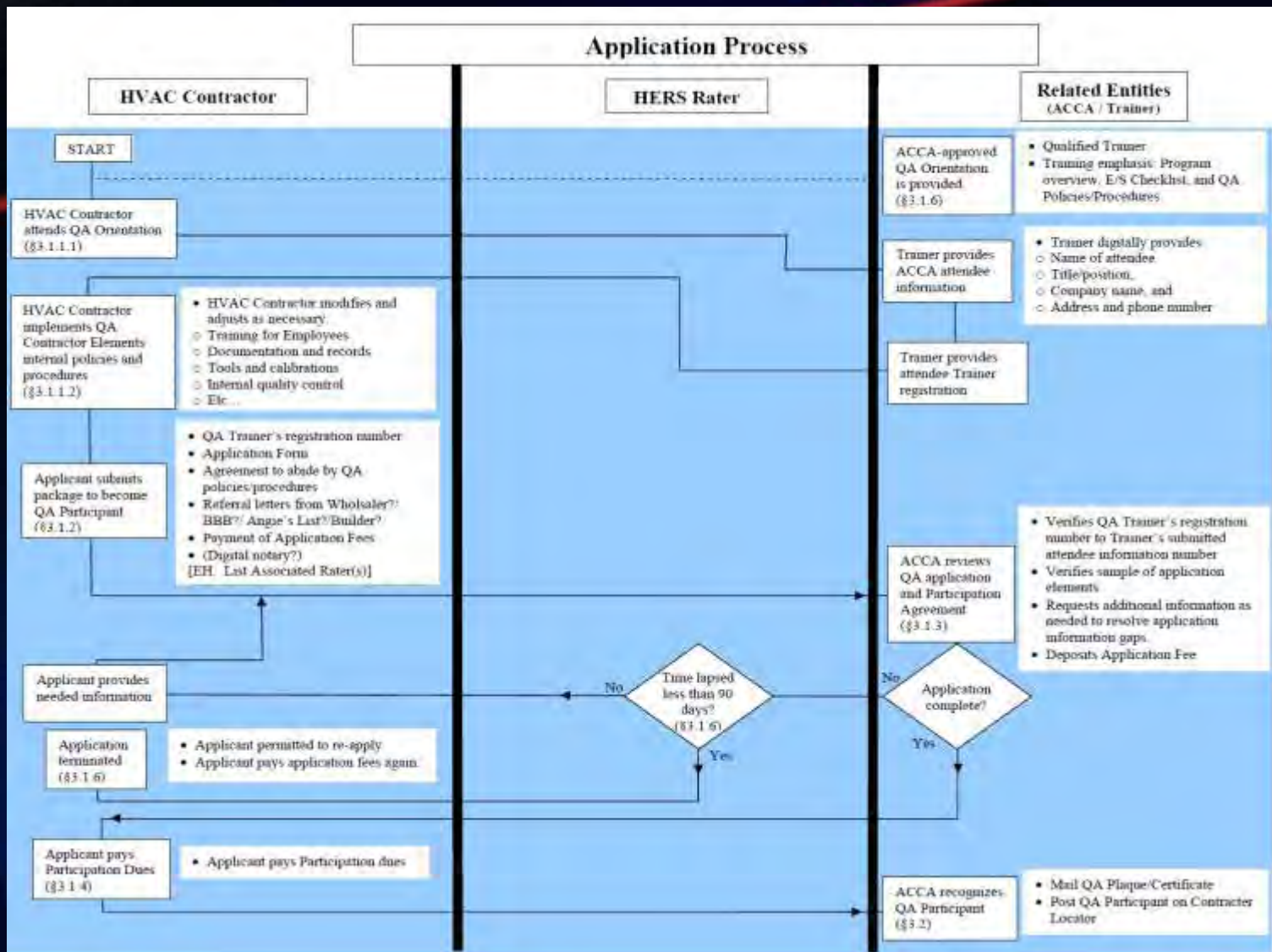
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# Quality Assured (QA)

- Steering Committee of leading HVAC Contractors
- Developed:
  - QA Elements (ACCA 5 QI Appendix)
  - QA Requirements
  - QA Agreement
  - [www.acca.org/qa](http://www.acca.org/qa)
- Approved by ACCA's Board of Directors

# Gaining Recognition



# ACCA QA Program

- **Gaining Recognition:**
  - Orientation
  - Application
  - Participation Agreement
  - Review
  - Recognition

# ACCA QA Program

- **Gaining Recognition:**
  - Orientation
    - Training...NOT
    - Overview of Energy Star
    - Overview of Checklists (Contractor and Rater)
    - Overview of the QA Program
  - Application
  - Participation Agreement
  - Review
  - Recognition

# ACCA QA Program

- **Gaining Recognition:**
  - Orientation
  - Application
    - Who
    - Where
    - Business information
      - Licenses
      - Insurance
    - Self-attest to QA Elements
  - Participation Agreement
  - Review
  - Recognition

# ACCA QA Program

- **Gaining Recognition:**
  - Orientation
  - Application – QA Elements
    - Business Prerequisites
    - Business Operations
    - Training and Certification
    - Consumer Interaction
  - Participation Agreement
  - Review
  - Recognition



# ACCA QA Program

- **Gaining Recognition:**
  - Application: QA Elements
    - Business Prerequisites
      - Licensing or Registration
      - Insurance
      - Code Requirements
      - Refrigerant Certifications, Training, and Equipment
      - Hazardous Materials Regulations

# ACCA QA Program

- **Gaining Recognition:**
  - Application: QA Elements
    - Business Operations
      - Employment
      - Safety Programs
      - Fleet Management
      - Quality Installation
      - Quality Maintenance
      - Quality Restoration
      - Instrumentation/Measurement Tools



# Equipment Design Elements

- Ventilation
- Building heat gain/loss load calculations
  - For NEW buildings/ducts: *Room-by-room* loads
  - For EXISTING buildings/ducts: *Block* loads



# Equipment Design Elements

- **Equipment sizing**
  - ACs:  $\leq 115\%$  of calculated load
  - HPs:  $\leq 115\%$  of calculated load (special cases 125%)
  - Furnaces: 100 - 140% of calculated load
  - Boilers: 100 - 115% of calculated load



# Equipment Design Elements

## Geothermal Heat Pumps Ground Heat Exchanger

- **Ground heat exchangers designed:**
  - The ground interface heat exchanger fluid temperatures [extremes] and flow rates used as the basis for design equipment capacity are within the range specified in OEM guidelines
  - The ground heat exchange design methodology incorporates:
    - building loads and total installed equipment capacity
    - ground heat exchanger type, materials, and geometry
    - soil thermal characteristics
    - climatic characteristics of the project location



# Equipment Design Elements

- **Matched system (per AHRI or CEE Directory)**
  - AHRI – [www.ahridirectory.org](http://www.ahridirectory.org)
  - CEE – follow links from [www.cee1.org](http://www.cee1.org)



# ***Equipment Installation Elements***

- **Airflow through the heat exchanger**
  - *Within  $\pm 15\%$  of design / equipment selection*
  - *Supported by OEM product data*
- **Refrigerant charge**
  - *Superheat method: w/in 5°F*
  - *Subcooling method: w/in 3°F*
- **Voltage/amps/grounding**
- **On Rate (Combustion)**
  - *On-rate (w/in 5% of nameplate)*
  - *Temperature rise*
  - *Nozzle selection and pump pressure (oil)*
  - *Combustion analysis OEM*
- **Venting (*comply with code requirements*)**
- **System controls (*per OEM recommendations*)**



# ***Duct Distribution Elements***

- **Duct leakage**
  - NEW residential / commercial buildings:
    - *Ducts located inside conditioned space:  $\leq 10\%$  total leakage*
    - *Ducts outside thermal envelope:  $\leq 6\%$  total leakage*
    - Or per EnergyStar™ guidance (new homes)
  - EXISTING residential / commercial buildings:
    - *$\leq 20\%$  total leakage, or*
    - *50% reduction of existing airflow leakage*
  - Or per local code requirement (if meet/exceed above)





# ***Duct Distribution Elements***

- **Airflow balance**

- For new or modified ducts: Room airflow is the greater of:
  - *Residential:  $\pm 20\%$  or  $\pm 25$  CFM of design / application requirements*
  - *Commercial:  $\pm 10\%$  or  $\pm 25$  CFM of design / application requirements*
- Unmodified existing ducts: *No requirements*



# ***System Documentation & Owner Education Elements***

- **Placing copies of required system documentation with the customer:**
  - Calculations
  - Measurements
  - Other records from Acceptable Documentation
- **Owner / operator education on pertinent operation, maintenance, and warranty issues.**

# ACCA QA Program

- **Gaining Recognition:**
  - Application: QA Elements
    - Business Operations
      - Employment
      - Safety Programs
      - Fleet Management
      - Quality Installation
      - Quality Maintenance
      - Quality Restoration
      - Instrumentation/Measurement Tools

# ACCA QA Program

- **Gaining Recognition:**
  - Application: QA Elements
    - Training and Certification
      - Continuing Education (6 hours / 12 hours)
      - Certification

# ACCA QA Program

- **Gaining Recognition:**
  - Application: QA Elements
    - Consumer Interaction
      - Interactions with Building Owners and Homeowners
      - Warranties
      - Service Agreements

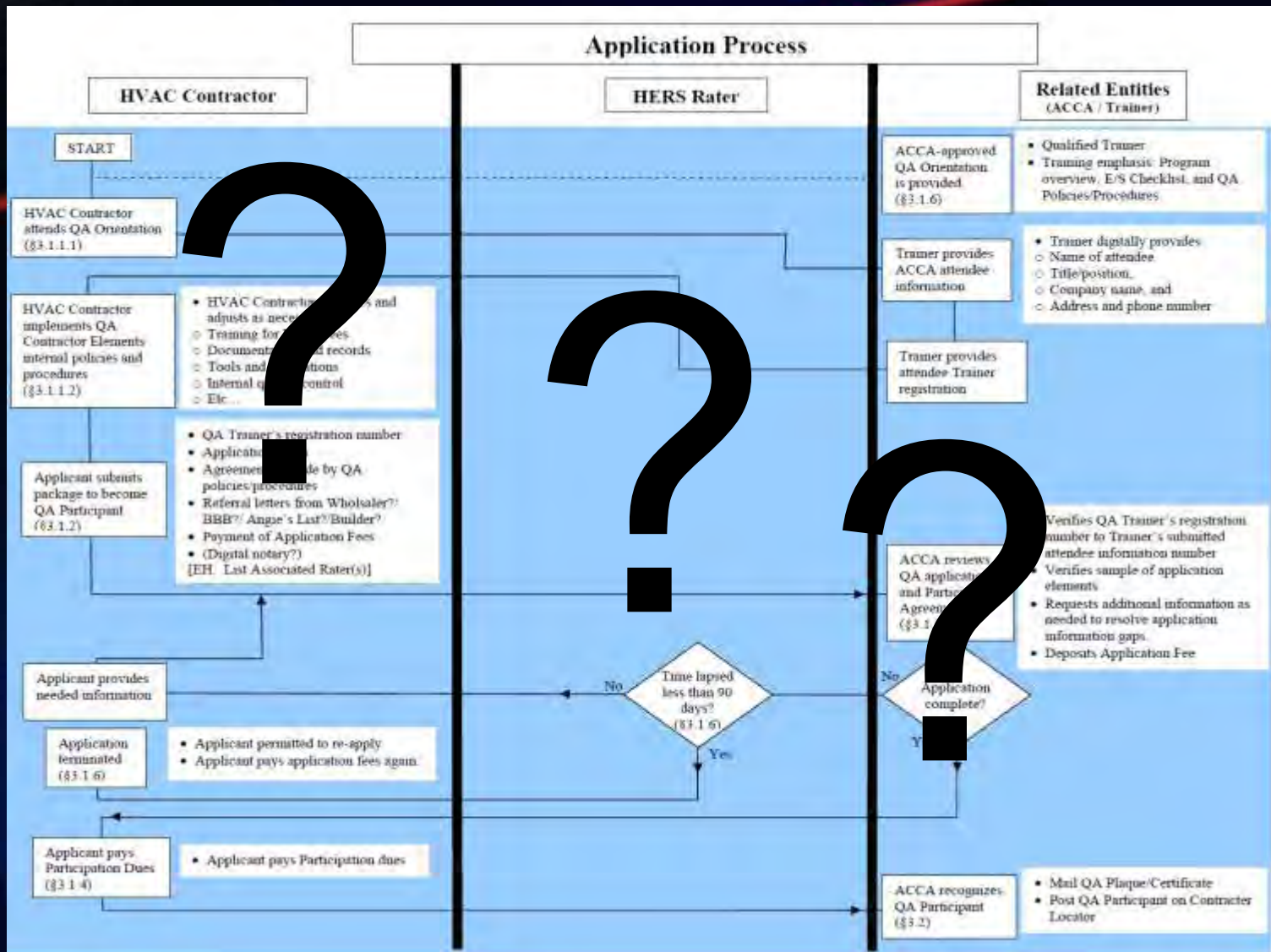
# ACCA QA Program

- **Gaining Recognition:**
  - Orientation
  - Application
  - Participation Agreement
    - Contractual
    - Spells out requirements
    - Outlines duties and responsibilities
  - Review
  - Recognition

# ACCA QA Program

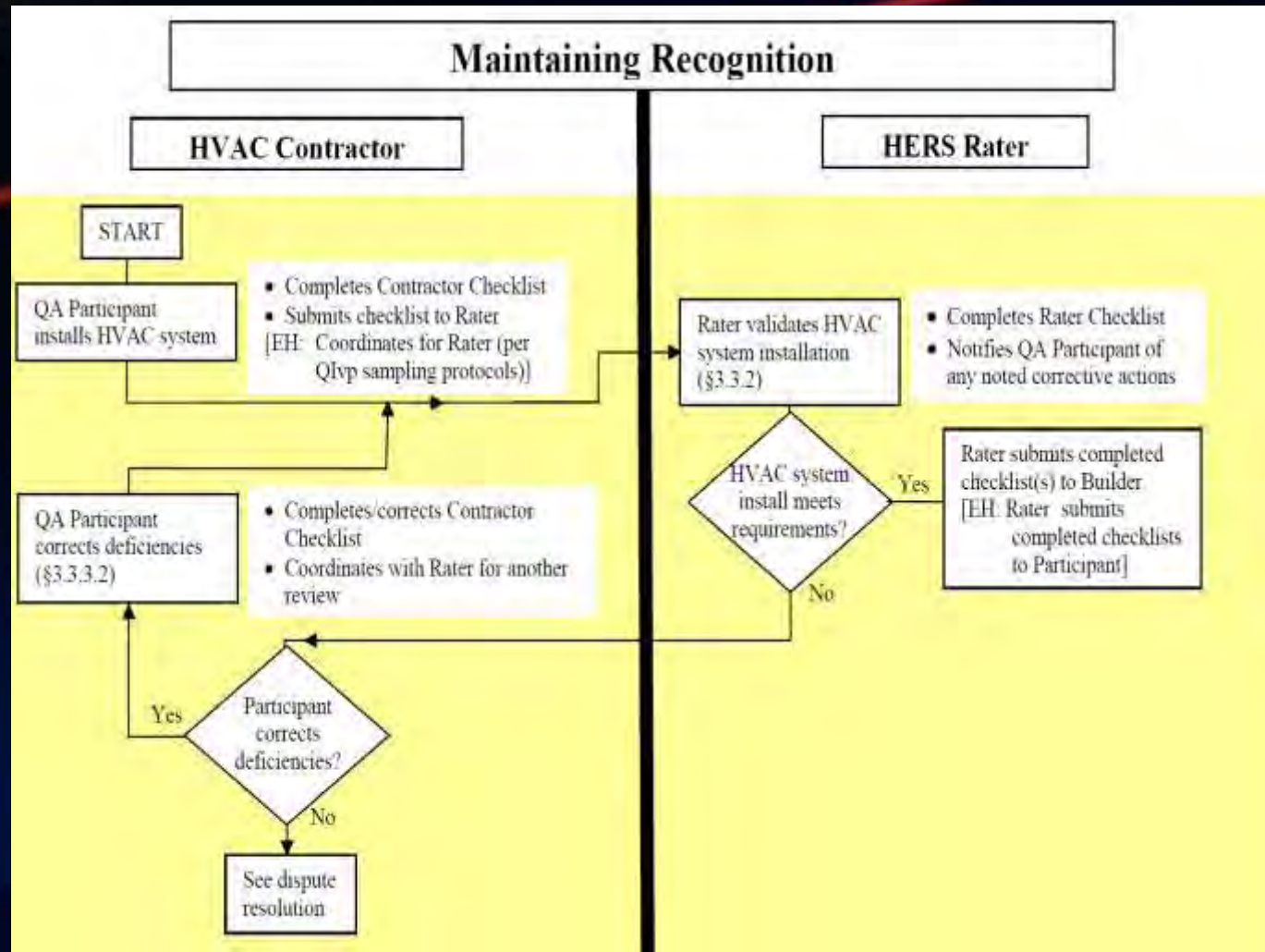
- **Gaining Recognition:**
  - Orientation
  - Application
  - Participation Agreement
  - Review – About 3-4 weeks
  - Recognition: Posted on QA Directory ([www.acca.org/qa](http://www.acca.org/qa))

# Gaining Recognition





# Maintaining Recognition



# ACCA QA Program

- **Maintaining Recognition:**
  - Participants Requirements
  - Third-Party Reports
  - Rater Validation of Installation
  - Compliance Reviews and Site Visits
  - Annual Reevaluation and Renewal

# ACCA QA Program

- **Maintaining Recognition:**
  - Participants Requirements:
    - QA Elements
    - ENERGY STAR Checklists (ACCA 5 QI Standard)
  - Third-Party Reports
  - Rater Validation of Installation
  - Compliance Reviews and Site Visits:
  - Annual Reevaluation and Renewal:

# ACCA QA Program

- **Maintaining Recognition:**
  - Participants Requirements
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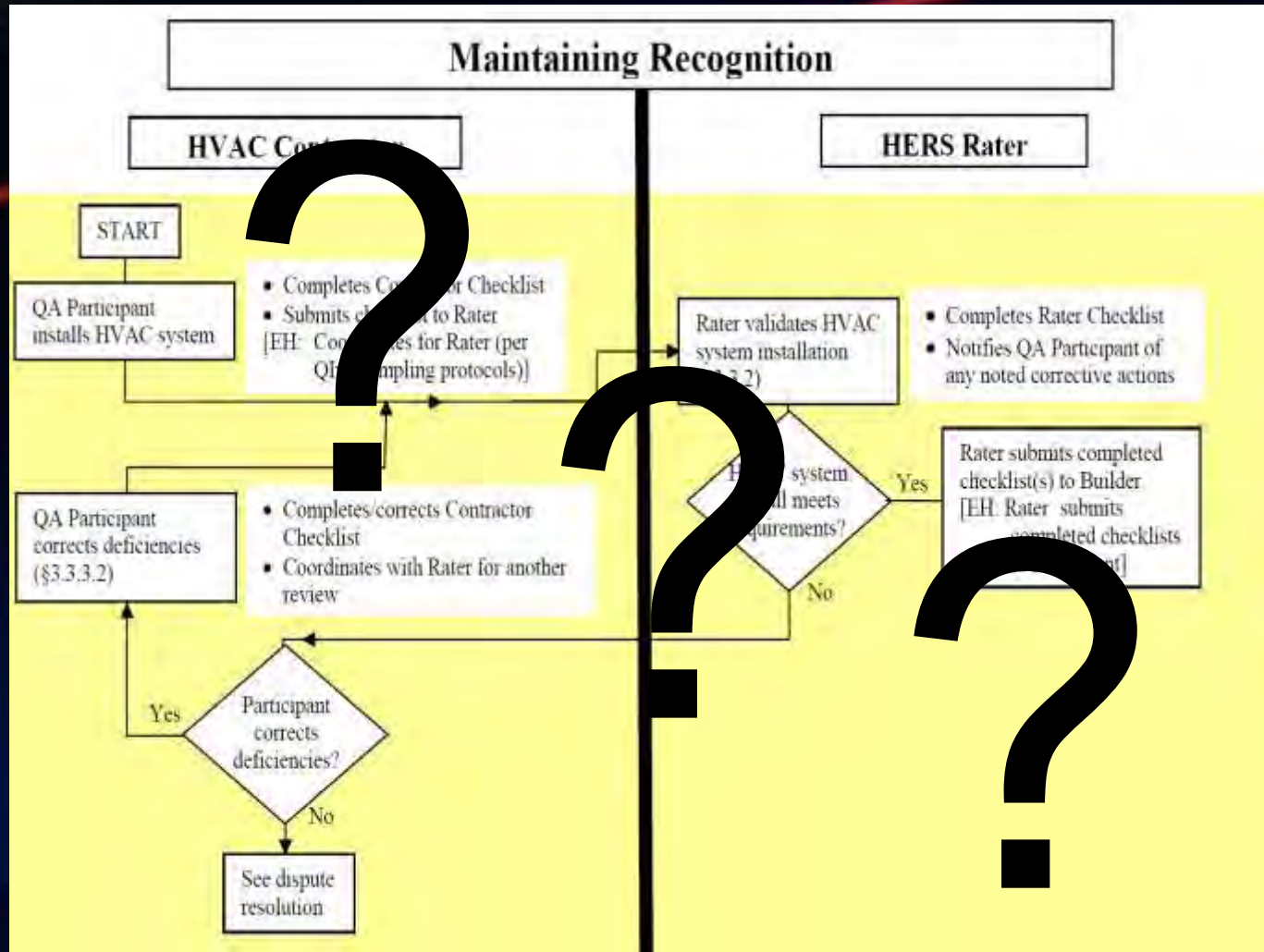
# ACCA QA Program

- **Maintaining Recognition:**
  - Participants Requirements
  - Third-Party Reports
  - Rater Validation of Installation
  - Compliance Reviews and Site Visits:
    - Administrator Review
    - Provide requested documentation, and/or access to requested information
    - Reasonable access to the QA Program Participant's office(s) or installation site(s)
    - Failure to comply may result in disciplinary action
  - Annual Reevaluation and Renewal

# ACCA QA Program

- **Maintaining Recognition:**
  - Participants Requirements
  - Third-Party Reports
  - Rater Validation of Installation
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  - Annual Reevaluation and Renewal

# Maintaining Recognition

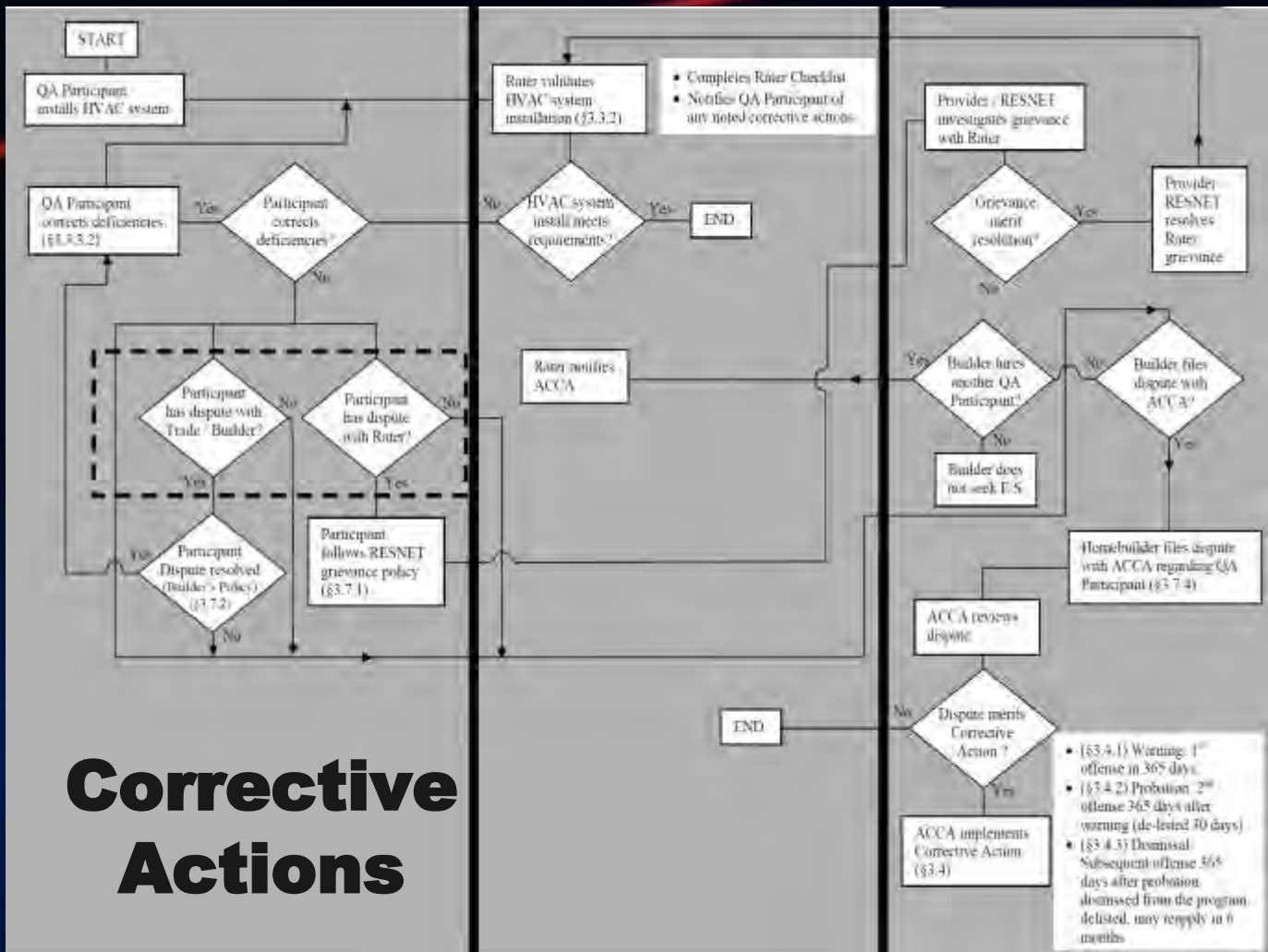




# ACCA QA Program

What if...mistakes happen....





# Corrective Actions

- §3.5.1) Warning: 1<sup>st</sup> offense in 365 days.
- §3.4.2) Probation: 2<sup>nd</sup> offense 365 days after warning (de-listed 90 days)
- §3.4.3) Dismissal: Subsequent offense 565 days after probation, dismissed from the program, delisted, may reapply in 6 months



# ACCA QA Program

## Corrective Actions:

- **Review Process:**

- Process of Review:
- Clarification or Rejection of a Report:
- Participant Notice and Response.
- Review of Participant Response:

- **Actions Upon Finding of Noncompliance**

- First Notice – Opportunity to Address Deficiency:
- Second Notice – Probation:
- Third Notice – Dismissal:

# ACCA QA Program

## Corrective Actions:

- **Review Process:**

- Process of Review:
  - QA Element (including E / S checklists)
  - Passage of time
  - Substantiation
- Clarification or Rejection of a Report
- Participant Notice and Response
- Review of Participant Response

# ACCA QA Program

## Corrective Actions:

- **Review Process:**

- Process of Review
- Clarification or Rejection of a Report:
  - Additional substantiation
  - 30 Day time limit
  - Can resubmit
- Participant Notice and Response
- Review of Participant Response

# ACCA QA Program

## Corrective Actions:

- **Review Process:**

- Process of Review
- Clarification or Rejection of a Report
- Participant Notice and Response
  - Request a response (30 days)
  - Fully address the report
  - If late, considered an admission of guilt
- Review of Participant Response

# ACCA QA Program

## Corrective Actions:

- **Review Process:**

- Process of Review
- Clarification or Rejection of a Report
- Participant Notice and Response
- Review of Participant Response
  - If late, issue non-compliance
  - Complaint resolved
  - Complaint un-resolved

# ACCA QA Program

## Corrective Actions:

- **Review Process:**
  - Process of Review:
  - Clarification or Rejection of a Report:
  - Participant Notice and Response.
  - Review of Participant Response:
- **Actions Upon Finding of Noncompliance**
  - First Notice: Opportunity to Address Deficiency
  - Second Notice – Probation
  - Third Notice – Dismissal



# ACCA QA Program

## Corrective Actions:

- **Actions Upon Finding of Noncompliance**
  - First Notice: Opportunity to Address Deficiency
    - Training
    - Tool
    - Policy/Procedure corrected
    - 12 month clock...starts
  - Second Notice – Probation
  - Third Notice – Dismissal

# ACCA QA Program

## Corrective Actions:

- **Actions Upon Finding of Noncompliance**
  - First Notice – Opportunity to Address Deficiency
  - Second Notice – Probation
    - Corrective actions taken
    - Off the QA Directory for 30 days
    - 12 month clock...starts
  - Third Notice – Dismissal

# ACCA QA Program

## Corrective Actions:

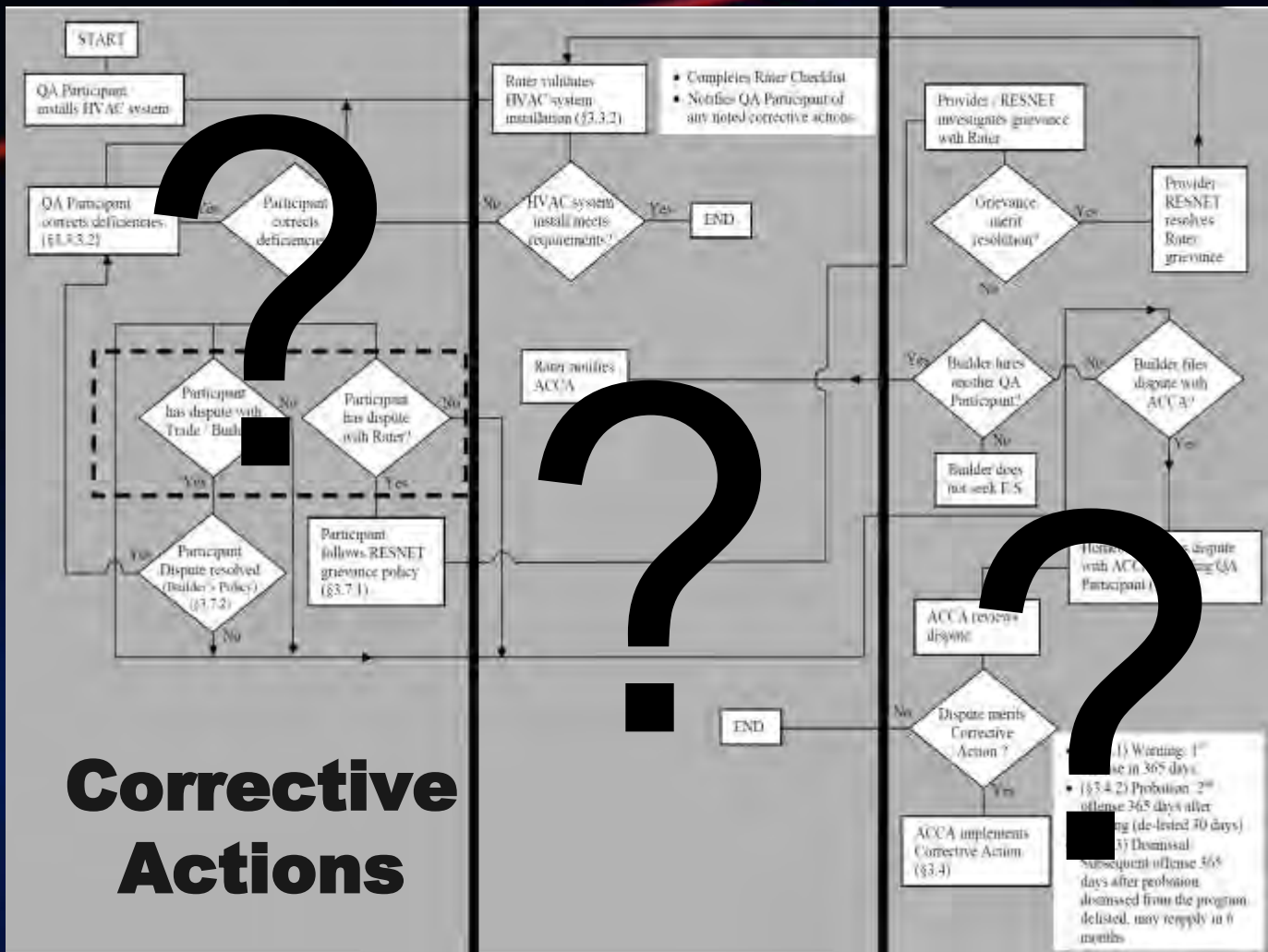
- **Actions Upon Finding of Noncompliance**
  - First Notice – Opportunity to Address Deficiency
  - Second Notice – Probation
  - Third Notice – Dismissal
    - Removal from the program for 6 months (at least)
    - Dependent on corrective actions taken

# ACCA QA Program

- **Re-application**
  - May re-apply after 6 months if:
    - Corrective actions have been implemented and
    - Corrective actions have been reviewed
- **Appeals and Dispute Resolution**
- **Dispute Resolution Outside of the QA Program**

# Avoiding Disputes with Builders

- **Appropriate Contract Language**
  - Review your current contracts
- **Include a timeline for resolution of issues**
  - Installers can make mistakes
- **Provide adequate supervision**
  - Train, check, train, check, train, check



# Corrective Actions

1) Warning: 1<sup>st</sup> offense in 365 days.  
 2) Probation: 2<sup>nd</sup> offense 365 days after offense (de-listed 70 days)  
 3) Dismissal: subsequent offense 565 days after probation dismissed from the program delisted, may reapply in 6 months



# ACCA QA Program

## Rater Checklist (ACCA sought modifications)

- Load calculation
- Equipment sizing
- AHRI Certificate
- Airflow (through heat exchanger)
- Refrigerant charge
- Controls
- Duct leakage
- Balancing

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- 2.1 Heat Loss / Gain Method:       Manual J v8       ASHRAE 2005       Other: \_\_\_\_\_
- 2.2 Duct Design Method:       Manual D       Other: \_\_\_\_\_
- 2.3 Equipment Selection Method:       Manual S       OEM Rec.       Other: \_\_\_\_\_

2.4 Outdoor Design Temperatures Used:<sup>5</sup>      1%: \_\_\_\_\_ °F      99%: \_\_\_\_\_ °F

2.5 Orientation of Rated Home (e.g., North, South): \_\_\_\_\_

2.6 Number of Bedrooms in Rated Home: \_\_\_\_\_

2.7 Conditioned Floor Area in Rated Home: \_\_\_\_\_ Sq. Ft.

2.8 Window Area in Rated Home: \_\_\_\_\_ Sq. Ft.

2.9 Infiltration Rate in Rated Home:<sup>6</sup>      Summer: \_\_\_\_\_      Winter: \_\_\_\_\_

2.10 Mechanical Ventilation Rate in Rated Home: \_\_\_\_\_ CFM

2.11 Design Latent Heat Gain: \_\_\_\_\_ BTUh

2.12 Design Sensible Heat Gain: \_\_\_\_\_ BTUh

2.13 Design Total Heat Gain: \_\_\_\_\_ BTUh

2.14 Design Total Heat Loss: \_\_\_\_\_ BTUh

2.15 Design Airflow: \_\_\_\_\_ CFM

2.16 Design Duct Static Pressure:<sup>7</sup> \_\_\_\_\_ Inches Water Column (IWC)

2.17 Copy of load calculations attached \_\_\_\_\_

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# ACCA QA Program Equipment Selection (*Manual S*)

Worksheet A Location and Design Conditions					
State: Nebraska	City: Beat <b>3</b>	Elevation = 1,323 Ft	Latitude = 40.04 <b>4</b>	North <b>6</b>	
Indoor Conditions, Heating: DB = 70 °F RH = 30 <b>5</b>		Indoor Conditions, Cooling: DB = 75 °F RH = 50%			
Table 1 Conditions 99% DB = -2 °F 1% DB = 95 °F		Grains Difference = 30		Daily Range = Medium	
Design Temperature Differences <b>1</b>		HTD = 70 - (-2) = 72 °F		CTD = 95 - 75 = 20 °F	

Form J1									
1 Name of Room:		Entire House							
2 Running Feet of Exposed Wall		31 + 32 + 3 + 13 + 27 + 51 = 173							
3 Ceiling Height (Ft) and Gross Wall Area (SqFt)		8 (173 x 8 = 1384)							
4 Room Dimensions (Ft) and Floor Plan Area (SqFt)		96 x 32 1,776 <b>9</b>							
5 Ceiling Slope (Deg.) and Gross Ceiling Area (SqFt)		0 1,776							
Type of Exposure	Const. Number	Panel Faces	HTM	Htg. Ctg.	Area or Length	Heating S-Ft	Cooling S-Ft	Latent S-Ft	Notes
64 Windows and Glass Doors	a. Unit A = 10	N	37.24	11.28	43.75	1,626			
	b. Unit A = 10	E/W	37.24	37.10	43.75	1,626			
	c. Unit B = 10	N	33.44	11.16	34.00	464			
	d. Unit B = 10	S	33.44	15.81	29.00	600			
	e. Unit C = 10	W	47.04	39.63	38.00	1,416			
	f. Unit D = 10	S	47.04	17.30	47.15	1,776			
	g. Unit E = 10	N	31.92	12.58	19.20	736			
	h. Unit E = 10	S	31.92	22.88	19.20	736			
65 Skylights	a. Unit 1 = 80	N	88.42	186.75					
	b. Unit 2 = 80	S	88.97	92.84					
7 Wood and Metal Doors	a. 11A		26.60	8					
	b. 11B		26.60	8					
	c.								
8 Above Grade Walls and Partitions	a. 14A-E		0.90						
	b. 15A-lefty wall		10.41						
	c. 15A-lefty part		0.90						
9 Below Grade Walls	a. 15A-4R-4		0.00						
	b. 15A-4R-6		4.71						
	c.								
10 Ceilings	a. 16B-30at		2.43	1.6	1,776	2,803			
	b.								
	c.								
11 Floors	a. 18R-csp		2.43	0.48	736	1,788	352		
	b. 22R-fgr		44.79		84	2,886			
	c. 21A-32		1.62		844	837			
	d.								
12 Infiltration	Heating Load (Btuh)			0.408		11,237			
	Sensible Load (Btuh)			ERcd	WAR	1,058			
	Latent Load (Btuh)			6.194	4	1,653			
	Internal					925	800		
13 Internal	a. Occupants at 230 and 200 Btuh					2,400			
	b. Scenario Number								
	c. Default Adjustments								
	d. Custom Appliances								
14 Subtotals	Sum Lines 5 through 12					52,184	20,548	2,491	
	EHF & ESGF					2,581	630		
15 Duct Loads	ELG						360		
	Winter Humidification Load					1,987	459	1,755	
16 Piping Load									
	Shower Heat								
20 AED Excursion & Latent Moisture Migration Load									
21 Total Load	Sum Lines 13 Through 19					59,000	27,000	6,000	



ACCA QUALITY ASSURED

# ACCA QA Program

## Equipment Selection (*Manual S*)

XYZ Air Conditioners – Detailed Cooling Capacities  
Model AC-30 with Coil AC-030

Evaporator Air		Condenser Entering Air Temp – DB (F)					
CFM	EWB (F)	85		95		105	
		Capacity		Capacity		Capacity	
		Total	Sensible	Total	Sensible	Total	Sensible
875	72	34,610	18,190	33,100	17,620	31,520	17,020
	67	31,400	22,240	30,000	21,650	28,520	21,040
	63	28,620	26,290	27,350	25,680	26,020	25,040
	57	27,840	27,840	26,800	25,740	25,740	25,740
1000	72	35,250	19,090	33,680	18,500	32,030	17,890
	67	31,990	23,660	30,530	23,060	29,000	22,440
	63	29,020	29,020	28,020	26,560	26,770	26,770
	57	29,020	29,020	27,930	26,560	26,770	26,770
1125	72	35,720	19,920	34,110	18,500	32,030	17,890
	67	32,430	25,010	30,930	23,060	29,000	22,440
	63	29,970	29,970	28,850	26,560	26,770	26,770
	57	30,000	30,000	28,850	28,850	27,640	27,640

This A/C unit's capacities vary (from the nominal 30,530 Btu/h) based on the operating conditions inside and outside of the home.



# ACCA QA Program

## Rater Checklist (ACCA sought modifications)

- Load calculation
- Equipment sizing
- AHRI Certificate
- Airflow (through heat exchanger)
- Refrigerant charge
- Controls
- Duct leakage
- Balancing

# Certificate of ARI-Certified Performance

The following

Single Phase, Split System: Air-Cooled Condensing Unit, Coil with Blower

Outdoor Unit Model Number: 24ABA436A30

combined with

Outdoor Unit Model Number: **24ABA436A30**

combined with

Indoor Unit Model Number: **CAP\*\*3621A\*\*+58MVB080-20**

manufactured by: CARRIER AIR CONDITIONING

under the Trade/Brand Name: Base 14 Puron AC

has been rated in accordance with

ARI Standard 210/240-2005 for UNITARY AIR-CONDITIONING AND AIR-SOURCE HEAT PUMP EQUIPMENT

and is certified by the Air-Conditioning and Refrigeration Institute to meet



ARI Reference #: 737995  
Today's Date: 04 / 05 /06  
Status: Active

CERTIFIED RATINGS ARE VALID ONLY FOR THE PARTICULAR COMBINATION OF INDOOR AND OUTDOOR UNITS LISTED IN THE AIR-CONDITIONING AND REFRIGERATION INSTITUTE'S DIRECTORY OF CERTIFIED EQUIPMENT. VISIT [WWW.ARIDIRECTORY.ORG](http://WWW.ARIDIRECTORY.ORG) TO VERIFY THAT THIS COMBINATION IS AN ACTIVE LISTING AND THE DATA LISTED ON THIS CERTIFICATE IS ACCURATE. SEARCH ON THE ARI REFERENCE # TO QUICKLY LOCATE THIS COMBINATION IN THE DIRECTORY.

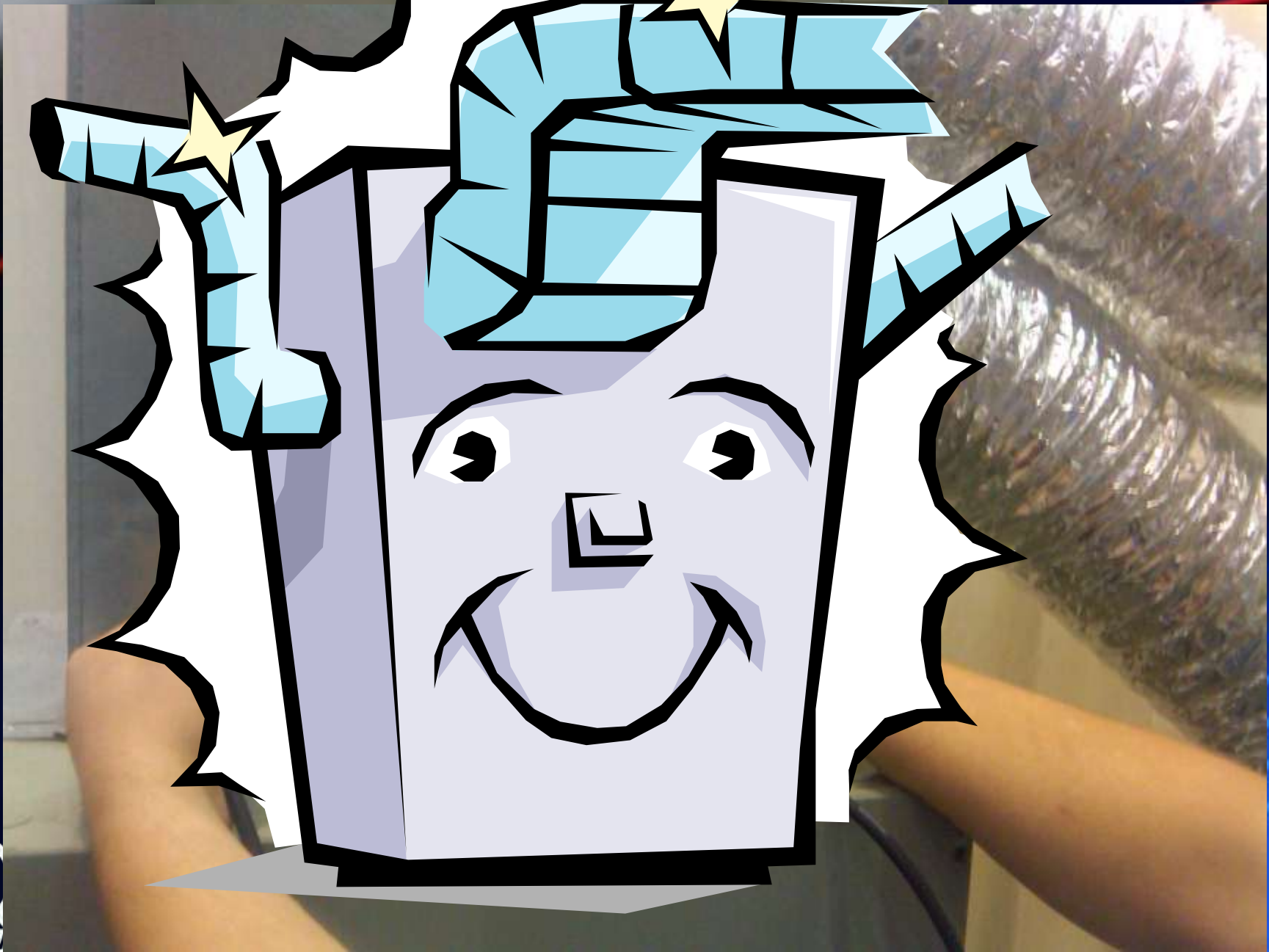
#### TERMS AND CONDITIONS

This Certificate shall be used for individual, personal, and confidential reference purposes only, and may be used only pursuant to the terms and conditions listed. This Certificate and the contents hereof are proprietary products of ARI. The contents of this Certificate may not, in whole or in part, be reproduced, copied, disseminated, entered into a computer database, or otherwise utilized, in any form or manner or by any means, except for the user's individual, personal and confidential reference. Contained herein are product information and certified ratings. ARI does not endorse the product(s) listed in this Certificate and makes no representations, warranties or guarantees as to, and assumes no responsibility for, the product(s) listed in this Certificate. ARI expressly disclaims all liability for damages of any kind arising out of the use or performance of the product(s), or the unauthorized alteration of data, listed in this Certificate.

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PSIG (Pounds per Square Inch Gauge)	Temperature °F
	Refrigerant Type
	R-410A (HFC)
180	64

**Just check the MATH**

54°F

Measured Thermometer:

54°F

Refrigerant sub-cooled:

10°F

110	172	141	170	143	127	121
115	184	153	183	155	138	132
120	198	165	196	167	149	143
125	212	178	210	180	161	154
130	227	192	224	193	173	166
135	242	207	239	208	186	179
140	258	222	255	223	200	192
145			272	239	214	206
150			289	255	229	221



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- Refrigerant charge
- Controls
- Duct leakage
- Balancing



# ACCA QA Program

Questions

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Answers



# ACCA QA Program Overview

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