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Contents

Welcome to VPMIA's 60th School of Instruction

And Welcome to Charlottesville. This yearbook is your resource for the SOI with an agenda on page 6, VPMIA information, the exhibitors on site, supporting advertisers, and technical articles.

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The President's Page

Fellow members,

It has been a great honor to be selected and serve this last year as your President. Being in the moment is surreal, the last year has gone by in a blink. I believe this is a great group of people and some of the best technical plumbing and mechanical minds in the country. Our resolute mission is to protect and inform the public. Now more than ever we must stay vigilant as the influx of new products is almost as great as the void of trained professionals that do plumbing and mechanical work. Please find time to guide and mentor the young men and women that you come into contact with. Even with the great tools we have to find and retain knowledge, skill cannot be saved on a server. Craftsmanship among trade-work is a beautiful thing to behold. The days of master tradesmen surveying the work done by their apprentices and making them redo it are all but gone. Remember the lessons of those that came before us, and pass on as much as you can. I leave you now as I pass the gavel into the capable hands of Mr. Dennis Hart.

My best wishes to you all.

Anthony V. McMahan

Anthony V. McMahan
President, VPMIA

VPMIA 60th ANNUAL SCHOOL OF INSTRUCTION

Agenda

Wednesday April 5

7:30 am - 8:00 am	***Registration/Sign in***
8:00 am - 9:30 am	***Fuel Gas Class —*** Omegaflex: Med Gas CSST
9:30 am - 10:00 am	***Break***
10:00 am - 11:30 pm	***Mechanical Class —*** Omegaflex: Liquid Fuel Piping
11:30 pm - 12:00 pm	***Report from Nominating Committee*** Nomination of 2022/2023 officers
12:00 pm - 1:00 pm	***Lunch***
1:00 pm - 2:30 pm	***Plumbing Class —*** Joyce Agency: Eyewash/mixing valves specification and installation.
2:30 pm - 3:00 pm	***Break***
3:00 pm - 4:30 pm	***Plumbing Class —*** Joyce Agency: Proper installation of backflow devices outdoors
4:30 pm - 5:30 pm	***General Membership Meeting***
5:30 pm - 6:00 pm	***President's Welcome***
6:00 pm - 7:30 pm	***Dinner***

Thursday April 6

8:00 am - 9:30 am	***Gas/Mechanical Class —*** UL: Understanding Codes and Standards
9:30 am -10:00 am	***Break***
10:00 am - 11:30 am	***Gas/Mechanical Class —*** UL: Understanding Codes and Standards
11:30 am - 12:00 pm	Visit Sponsor Tables
12:00 pm - 1:00 pm	***Lunch***
1:00 pm - 2:30 pm	***Gas/Mechanical Class —*** UL: Commercial Cooking
2:30 pm - 3:00 pm	***Break***
3:00 pm - 4:30 pm	***Gas/Mechanical Class —*** UL: Commercial Cooking
5:00 pm - 6:00 pm	***Reception***
6:00 pm - 8:00 pm	***Banquet:*** **Awards/Officer Installation**

Friday April 7

7:00 am - 8:30 am	***Breakfast Buffet***
8:30 am - 10:00 am	***Plumbing Class*** — McWane: Underground DWV Materials/Installations
10:00 am - 10:30 am	***Break***
10:30 am - 12:00 pm	***Plumbing Class*** — McWane: Proper firestopping of plumbing penetrations

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Resolution of Rexpect for
Curtis "Curt" W. Campbell, Sr.

Whereas our colleague and friend Curt Campbell of Chesterfield, Virginia passed on September 22, 2022, at the age of 75; and

Whereas Mr. Campbell graduated from Varina High School in 1967 and then served our nation in the U.S. Army until his honorable discharge in 1971; and

Whereas Mr. Campbell joined Chesterfield County as a plumbing inspector on February 2, 1987, earning multiple promotions during his career leading to his promotion to building inspection supervisor on September 20, 2008; and

Whereas Mr. Campbell retired from the Chesterfield County Department of Building Inspection on October 1, 2015, after providing twenty-eight years of dedicated service; and

Whereas Mr. Campbell is known for his technical knowledge of the profession exemplified by achieving 7 professional certifications, and dedication in seeking opportunities to be a mentor and share his knowledge and experiences with colleagues and the public; and

Whereas Mr. Campbell generously devoted his time, talent, and leadership to service with the Virginia Plumbing and Mechanical Inspectors Association culminating in his election to vice president of the association in 2014; and

Whereas Mr. Campbell has received professional recognition for his contributions to the plumbing and mechanical inspection profession through receipt of the Virginia Plumbing and Mechanical Inspector's Association's Gordon L. Dameron Award for Outstanding Service in 2012 and the Lifetime Membership D. Paul Jack Active Award in 2016; and

Whereas Mr. Campbell has served the residents of the Commonwealth of Virginia through his work as an advanced instructor for the Virginia Department of Housing and Community Development's Jack A. Proctor Building Code Academy; and

Whereas Mr. Campbell is survived by his wife, Vernie Campbell; children, Curtis (April), Pamela, Gordon, and Cheree (Sean); grandchildren, Lyndsey (David), Ashley (Ben), Alyssa, Jordyn Piper, Kensley, Devin, Garrett and Kalynn; and great-grandchildren, Maddox, Weston, Sawyor, Harlan, Faith, Sophie and Harper; and

Whereas The Virginia Plumbing and Mechanical Inspectors Association notes with great sadness the passing of Curt Campbell;

Now, Therefore, Be It Resolved, *That the Officers, Board of Directors, and the entire membership of the Virginia Plumbing and Mechanical Inspectors Association join the family of Curt Campbell in celebration of his life and do also offer their most heartfelt sympathy at the loss of this cherished family member; and*

Be it further Resolved *that the Virginia Plumbing and Mechanical Inspectors Association stands in readiness to assist the family of Curt Campbell in any manner desired or requested; and*

Be it further Resolved *that this resolution be respectfully submitted to Curt Campbell's family as a permanent memorial to the memory of Curt Campbell.*

Adopted this 26th, day of September 2022

Anthony McMahon, VPMIA President

ATTEST:

Dennis Hart, VPMIA Vice President

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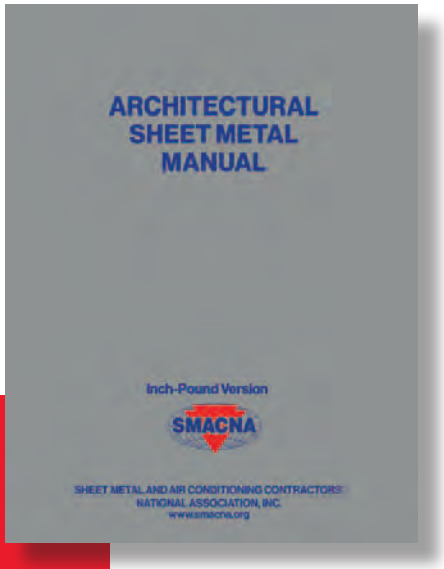

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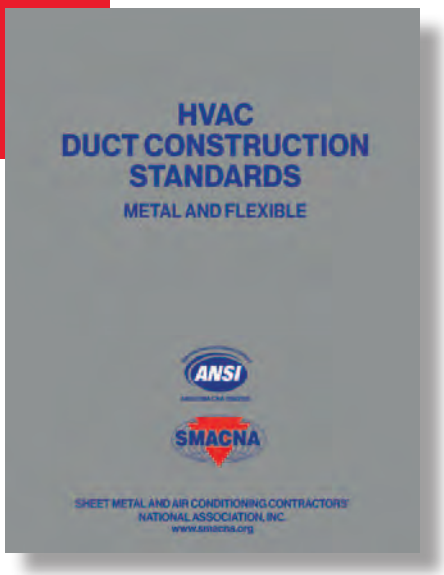

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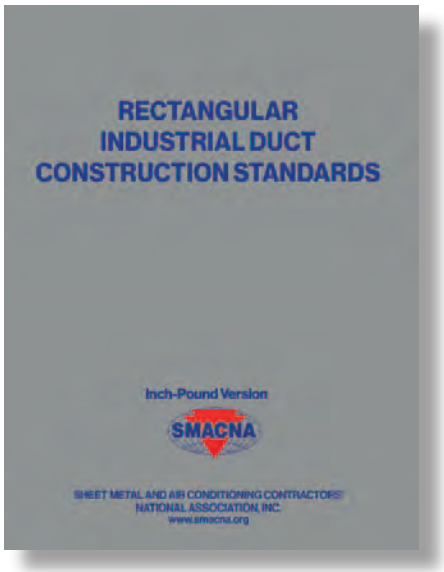

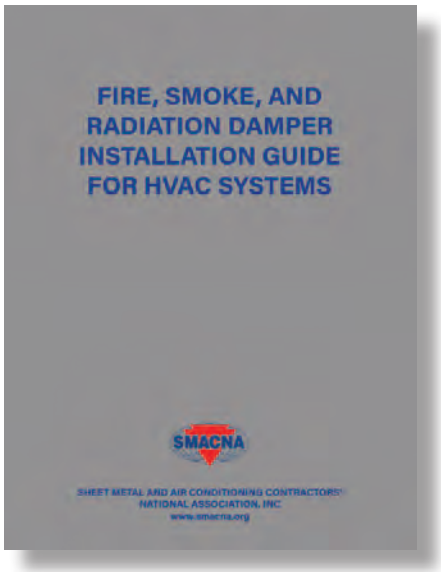

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Promo code expires 12/31/2023

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Treasurer	Peter Kapitan
Executive Secretary	Chris Martin
Immediate Past President	Ellis McKinney
District 1 Director	Tom Clark
District 2 Director	Bane Compton
District 3 Director	Donald Mimms
District 4 Director	Randy Pearce

2022 Committees, and Chair

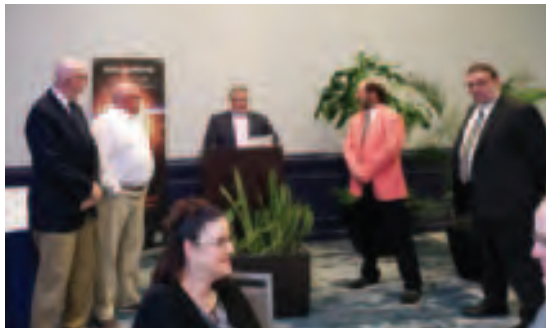
Advertising/Yearbook	Ron Bladen
Auditing	Dennis Hart
Awards	Tom Clark
ByLaws	Dustin McLehaney
Certification/Education	Anthony McMahan
Finance	Peter Kapitan
Information Technology	Jane Kim/ Anthony McMahan
Legislative	Ron Clements
Membership	Chris Martin
Nominating	Ellis McKinney
PMG Code Committee	Dennis Hart
Time & Place/School of Instruction	Bob Adkins
BCAAC (Ad Hoc)	Randy Pearce
Building Safety Month (Ad Hoc)	Tom Clark
VA Code Education Conference (Ad Hoc)	Dustin McLehaney
VBCOA Liaison (Ad Hoc)	David Beahm
Region 7 ICC Liaison	Jane Kim
DPOR Liaison	Vernell Woods

Acknowledgments

Publishing the Yearbook is a complicated task and many who made it happen need to be recognized. Yeoman's work was done by Advertising & Yearbook Committee members Vic Hines and John Seay. Technical Articles were provided by ICC, written by Jim Cika, Director, ICC PMG Technical Resources, and the other from the Air Conditioning Contractors of America, written by Wes Davis, Director of Technical Services. Jane Fitzgerald conducted an interview with VPMIA Lifetime member Jesse Hurt which tells his history with VPMIA. We extend our appreciation to Jesse for sharing his experiences with us.

We want to thank those individuals and companies that purchased ads. And, don't forget to visit the different Tabletop Displays and express thanks for their contributions to our SOI.

— Ron Bladen, Chair, Advertising and Yearbook Committee



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A rewarding career

Past VPMIA President, Jesse Hurt

By Jane Fitzgerald

Recently I spoke with Jesse Hurt regarding his career experiences and decades-long relationship with the organization. Jesse's interest in electrical, building, plumbing and mechanical work began in his mid-teens. His mother encouraged his desire to learn a trade and earn a better living. At 18, Jesse joined the Army and developed these skills further. After Fort Bragg, NC, he was posted in South Korea with the 82nd Airborne Division, patrolled the DMZ, and provided instruction to South Korean soldiers. After that life-broadening adventure, Jesse returned to Virginia, married Joyce, and began his career.

First interest in VPMIA

In 1974, Jesse heard about VPMIA; he attended a Conference and then joined as an active member. The classes were a benefit, and it was not long before Jesse found himself serving on some committees. He enjoyed the fellowship with others in his line of work.

During that time, VPMIA sponsored summer picnic meetings and holiday gatherings in which one's family could participate. The wives – through the Ladies Auxiliary –helped the organization with tasks like registration, mailings, and picnic foods. The Auxiliary also organized side trips and activities for spouses to take part in during VPMIA meeting times.

What lead to your serving as President?

Jesse jumped from Treasurer to Vice President and served as President from 1981-82. He said he enjoyed each position. As for his accomplishments, he pointed out that during his term, members and officers worked together on different projects; this fostered harmony in the discussions and encouraged good results through a team effort.

As Past President, Jesse served on a variety of committees: Bylaws, Nominating, and more. Also, in 1988 he served as president of VBCOA. During his VBCOA term, Jack Proctor called him for help because Jack wanted to start a Code Academy. Again, Jesse noted that team efforts and dedication bought the Code Academy to Virginia.

It should be noted that Jesse was the recipient of the Outstanding Service, Gordon I. Dameron Active Award, and the Lifetime Membership, D. Paul Jack Active Award.

What about VPMIA has stood out to you over the years?

VPMIA provides utility in its access to affordable training for members, allowing them to retain required career certifications. VPMIA also offers opportunity for professionals to work together.

(Continued)

Jesse Hurt and his personal, peach cobbler.

Jesse Hurt and his peach cobbler.

VPMIA Past Presidents

CHARLES E. MANNION	1963	JESSE R. HURT	1982	GUY TOMBERLIN	2003/2004
PAUL C. KING	1964	CHARLES DEDIAN	1983	GEARY SHOWMAN	2005
GORDON I. DAMERON	1965	KENNETH R. SNYDER, SR.	1984	MICHAEL THUOT	2006
D. PAUL JACK	1966	LAWRENCE J. NUCKOLS	1985	JOHN SEAY	2007
FRANK B. BOSMA	1967	JOHN W. THURSTON	1986*	DENNIS MARTINELLI	2008
U. EARL ALLEN	1968	WILLIAM F. HINES	1987	JOHN MILLS	2009
HARRY CONTE	1969	LESLIE A. COURTNEY	1988	WAYNE KUSHNER	2010
JAMES B. JONES	1970	JIMMY A. ENGLISH	1989	ROBERT ADKINS	2011
L. W. FURMAN	1971	DOUGLAS L. STOVER	1990	BANE COMPTON	2012
GEORGE H. WILLIAMS	1972	ROBERT M. BROOME	1991	RON BLADEN	2013
W. T. DRAKE	1973	PAUL D. HOSTETLER	1992	PAUL RIMEL	2014
BENJAMIN BIANCO	1974	DENNIS W. McNAUGHTON	1993	SKIP HARPER	2015/2016
J. L. SHIFFLETT	1975	JOHN S. TRENARY	1994	RICHARD GRACE	2016
HOMER O. DENNIS	1976	MICHAEL D. REDIFER	1995/1996	DUSTIN MCLEHANEY	2017
JULIAN E. MEREDITH	1977	KATHLEEN T. DYE	1997	JAMES ANJAM	2018
EDWARD T. PARSONS	1978	HASSEL DeSHAZO	1998	TOM CLARK	2019/2020
EDWARD J. BALDWIN, JR.	1979	ROY N. McFARLAND, JR.	1999/2000	ELLIS MCKINNEY	2021
HENRY A. RODÉS	1980	CLEATIS DYE, JR.	2001		
RUDOLF SCHROECK	1981	CHARLES GERBER	2002		

Career (Continued)

Major projects, such as Bylaws, take everyone's engagement to remain current and useful.

Jesse recalled a Virginia Board of Contractors story from the 1990s. A change was needed so that a Building Official could serve on this Board. He spoke with a local legislator who took up the challenge and offered legislation that was approved in the Virginia Legislature. Then Governor George Allen called upon Jesse to serve in that new position, and he accepted. At that time, Jesse managed 17 individuals in Albemarle County and held several positions–Director of Inspections, Zoning Officer and Fire prevention officer (to assist State police investigations). Jesse and Paul Hostetler, who worked for him at that time, composed questions for the plumbing exam used for contractors. Paul later served as VPMIA President.

At the 2014 SOI: Joyce Hurt (r) with Ethel Showman and Paul Rimel.

Any favorite VPMIA memory? Yes.

One was at a VPMIA conference held in Staunton and Jesse was Orange County official at that time. VPMIA Treasurer, Edward (Jud) Baldwin, knew of Jesse's love of desserts so he arranged for the hotel staff to surprise Jesse at the banquet by presenting him with an entire sheet cake of peach cobbler, "just for you." Jesse says he tried to eat it all.

Joyce, his wife of 60 years, has been very supportive of his VPMIA involvement. She attended SOIs with him, and took part in activities the Ladies Auxiliary planned for attending spouses and children. Jesse noted that family matters for support of members' active participation. Joyce added that while she was not an officer when the SOI was in Charlottesville, she arranged activities including a day trip to Monticello, a fashion show, and a luncheon at the historic Michie Tavern. Joyce also took pride in corralling Ethel Showman into the Auxiliary where Ethel remains active!

Jesse expressed his delight to watch John Seay move up through the ranks of VPMIA to become president. (John confirmed that there was one requirement when Jesse offered him an inspector position with Albemarle County–that he would become a VPMIA member.)

The summertime meetings and training opportunities at Graves Mt Lodge continue to be a source of fellowship for Jesse. I heard that "back in the day," there were more social events and picnics, and at one time there was an annual softball game – the inspectors played the contractors! Today VPMIA can still count on Graves Mt Lodge as a special experience.

Looking forward, Jesse noted changes and improvements VPMIA has made over the years, including more active ICC involvements and increased cooperation and coordination at the state level. And it continues.

In summary, Jesse's has been an interesting career, including his involvement with VPMIA and he acknowledges it all as a basically good experience. Join us in congratulating Jesse on his 60th Wedding Anniversary and on his rich history with VPMIA. This interview ended with Jesse reminding me, **"life is like ice cream–you have to lick it!"**

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Code changes on A2L refrigerants

Based on changes approved during the 2021 Group A code cycle, for the 2024 International Building, Fire, and Mechanical Codes.

Nearly 200 years have passed since Jacob Perkins patented the vapor-compression cycle in 1835, which began the history of refrigerants. The vapor-compression cycle uses a refrigerant to transport heat from the cold side to the hot side of a refrigeration system, heat pump or air-conditioning system. We use the same thermodynamic cycle today, though the refrigerants have changed.

A brief history of refrigerants

In the beginning, all refrigerants existed in nature or were used in industrial processes, and thus, were easily obtainable. By the 1930s, critical safety issues involving many of these early refrigerants emerged, including cases of fires and poisoning caused by refrigerant leaks. Synthetic safety refrigerants (chlorofluorocarbons or CFCs) were then invented and deployed on a global scale, with the development of partially chlorinated refrigerants (hydrochlorofluorocarbons or HCFCs) continuing in the 1950s. By the early 1970s, it was discovered that CFC and HCFC refrigerants caused a breakdown of the ozone layer. While HCFCs are comparatively lower in ozone-depleting potential and CFCs have a particularly high ozone-depleting potential, both still wreak havoc. The low reactivity of CFCs gives them a lifespan that can exceed 100 years, giving them time to diffuse into the upper stratosphere, where ozone loss could result in harm to our health and to our environment.

In response to a dramatic seasonal depletion of the ozone layer over Antarctica, in 1987 Canadian diplomats forged a treaty, the Montreal Protocol, that called for drastic global phasedowns in the production of CFCs that deplete the ozone layer. It went into effect in 1989, reducing the ozone-depleting potential load in the atmosphere and considerably decreasing the global warming impact. Substitute refrigerants (hydrofluorocarbons or HFCs) replaced the void left by CFCs and HCFCs. While HFC refrigerants have an ozone-depletion potential of zero, they are potent greenhouse gases with a medium-to-high global warming potential (GWP). Their usage has been scrutinized and they are included in the Kyoto Protocol and are regulated under the 2019 Kigali Amendment to the Montreal Protocol due to their global warming potential, a metric that compares the total contribution of a given mass of the refrigerant gas to an equivalent mass of carbon dioxide or C02.)

Many refrigerants, including HFCs, are potent greenhouse gases. Scientific investigations show that while refrigerant systems are not intentionally vented to the atmosphere, since industrial refrigeration systems frequently require charges of hundreds of pounds of refrigerant, a leaky refrigerant system — especially within air-conditioning units in developing countries — can have an immense impact on global warming. Their growing consumption in building systems would eventually make HFCs a top global warming contributor if phasedown measures were not introduced. In late 2021, the United States Environmental Protection Agency (EPA) issued a rule, the first regulation under the American Innovation & Manufacturing (AIM) Act of 2020, effectively implementing legislation that mandates an 85% economywide phasedown in HFC refrigerants over the next 15 years. The phasedown is expected to avoid HFC emissions of 900 million metric tons of CO2-equivalent by 2035 and avoid up to 0.5°C of global warming by 2100.

Next-generation refrigerant A2L

According to the International Institute of Refrigeration, refrigeration technology and air conditioning take up about 15% of the electricity consumption worldwide, making the quest for energy-efficient solutions ever more relevant. Just as HFC refrigerants replaced the void left by CFCs and HCFCs, the phasedown of HFCs has ramped up a growing acceptance of the use of A2L refrigerants as a substitute in many applications. The A2L subgroup, as categorized by ASHRAE Standard 34, are a class of refrigerants that have lower toxicity and flammability (flame propagation speed is less than 10 cm/s) compared to other classifications — A = non-toxic, 2 = flammable, L = low burning velocity — making it the second-safest refrigerant category. The A2L refrigerants also have a significantly lower global warming potential than A1-class HFCs, so A2L use is a key part of the HFC reduction plan. Globally, A2Ls have been used safely for years. As of December 2018, more than 68 million air conditioners using A2L refrigerants have been installed around the world.

Obtaining sustainable refrigerant solutions is a fine balance between affordability, safety, and environmental concerns. Last year, the EPA adopted a final rule accepting six refrigerant alternatives for use in new residential and light commercial air conditioners and heat pumps that meet the requirements in UL 60335-2-40 (Edition 3) for air-conditioning equipment. Each lower GWP alternative — R–32, R–452B, R–454A, R–454B, R–454C and R–457A — is classified by ASHRAE as A2L.

A2L code change proposals approved

Since A2Ls are new to the U.S. and these replacement refrigerants have different flammability characteristics, safety, training, and building code updates are important considerations. During the 2021 Group A code development cycle, several proposed code changes were submitted for the International Building Code (IBC), International Fire Code (IFC) and International Mechanical Code (IMC) that would permit the usage of A2L refrigerants, consistent with ASHRAE Standard 15-2019 and UL 60335-2-40, which are referenced in the EPA's rulemakings. Fourteen code change proposals were approved that impact the use of A2L refrigerants for human comfort; four proposals submitted for the IBC, four submitted for the IFC and six submitted for the IMC. (These approvals are subject

to certification by the ICC Validation Committee and confirmation by the International Code Council Board of Directors in accordance with Section 10.1 of Council Policy 28 — Code Development.)

Approved A2L changes to the IBC and IFC include:

• Differentiation of lower flammability refrigerants from other higher flammability gases in storage by using the classifications and labeling provisions of the 7th edition of the Globally Harmonized System of Classification and Labelling of Chemicals, and

• for correlation with the IMC.

Approved A2L changes to the IMC include:

• High probability equipment using Group A2L, A2, A3 or B1 refrigerant shall comply with UL 484, UL/CSA 60335-2-40, or UL/CSA 60335-2-89. By adding this requirement, the code clarifies what safety standards should be used for equipment utilizing these refrigerants. This is consistent with the ASHRAE 15 Standard, Safety Standard for Refrigeration Systems

• IMC refrigerant Table 1103.1 was updated with the new refrigerants that have been added to the ASHRAE Standard 34, Designation & Safety Classification of Refrigerants. Table 1103.1 is now consistent with ASHRAE 34.

• High probability direct systems for human comfort must use either Group A1 or A2L refrigerant. Other refrigerants can be used provided the maximum charge does not exceed 6.6 lbs for residential applications and 22 lbs for commercial units. This requirement is consistent with ASHRAE 15.

• Machinery rooms for Group A2L and B2L refrigerant must comply with elevated temperature, refrigerant detector, and ventilation requirements consistent with ASHRAE 15.

• The new ASTM A333-18 Standard, Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service and other Applications with required Notch Toughness, has been added to Table 1107.4, Refrigerant Pipe. Table 1107.4 is now consistent with ASHRAE 15.

Through 2021, except in limited instances, the IMC did not permit A2L refrigerants for human comfort uses. The fire service had safety concerns about A2L flammability, but these have been recently resolved through additional analysis by the Air Conditioning, Heating and Refrigeration Institute with testing performed by UL (Underwriters Laboratories).

These approvals, which go into effect with the 2024 IBC, IFC and IMC, permit the use of A2L refrigerants for human comfort uses, consistent with industry standards, and will help to facilitate the phasedown of HFCs following EPA rules.

Legislation driving the next generation of refrigerants

Understanding that the U.S. needed to move to a next-generation refrigerant, the bipartisan AIM Act — which was included in the Consolidated Appropriations Act of 2021 — was signed into law in December 2020. Among other things, the legislation grants the EPA the authority to regulate the transition to next-generation refrigerants and implement a phasedown of the production and consumption of HFCs over the next 15 years, mirroring the Kigali Amendment phasedown. The application-specific program went into effect on Jan. 1, 2022, and allowances — representing the privilege granted to a company to produce or import HFCs in a given year — will be required for the production and consumption of HFCs.

The EPA's Significant New Alternatives Policy (SNAP) program was established under Section 612 of the amended Clean Air Act of 1990 and evaluates and approves alternatives to substances heavily reliant on HFCs within a comparative risk framework in major industrial use sectors. The SNAP program continuously generates evolving lists of acceptable and unacceptable substitutes to promote a smooth transition to safer alternatives. Manufacturers, refrigerant producers and users can submit a proposed substitute for consideration, and the program evaluates overall risks to the environment and human health.

Conclusion

More than ever, refrigerants are a necessity in a world where cooling and heating needs are growing. The selection of the right refrigeration has a great impact. While some of yesterday's solutions have had consequences for today's environment, it is imperative that the industry looks ahead to find future-proof solutions to current challenges. Doing so effectively will require a solid working knowledge of the current standards, legislation and emerging technologies, and an eye on the future in terms of safety and environmental responsibility.

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Based in the Northern Virginia D.C. Metro area, Mike formerly worked for a fire protection manufacturer and was a volunteer firefighter. Mike holds a Business Degree with a specialization in entrepreneurship and brings strategic business planning to the Viega team.

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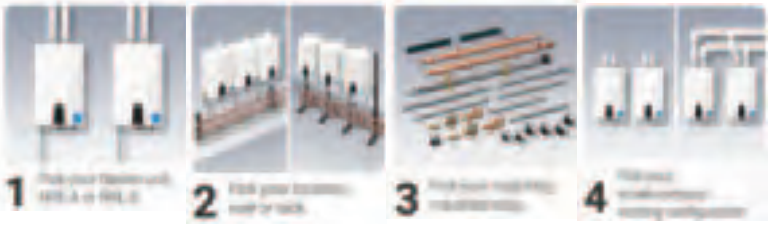

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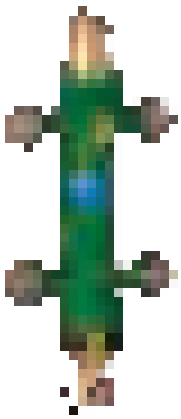

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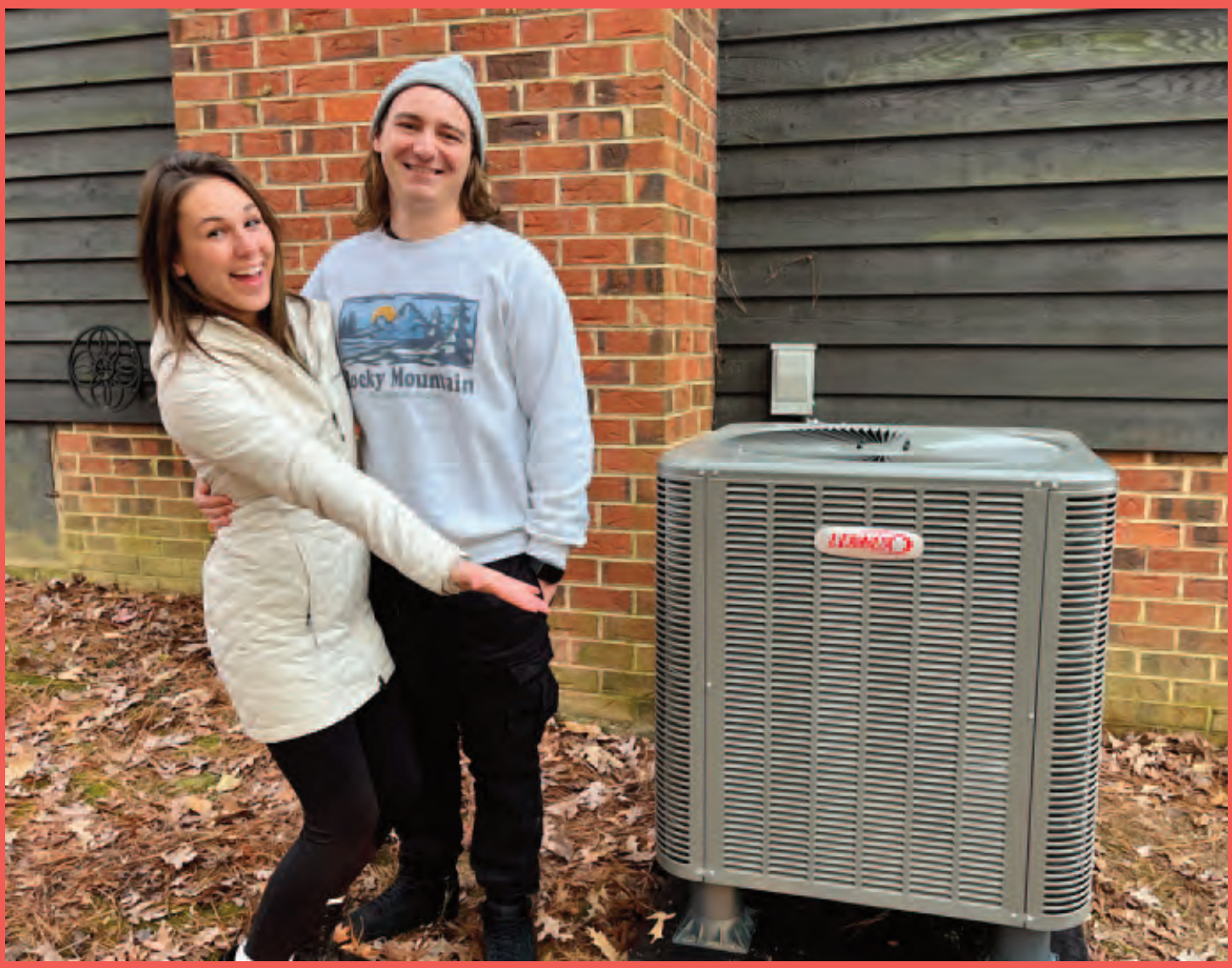

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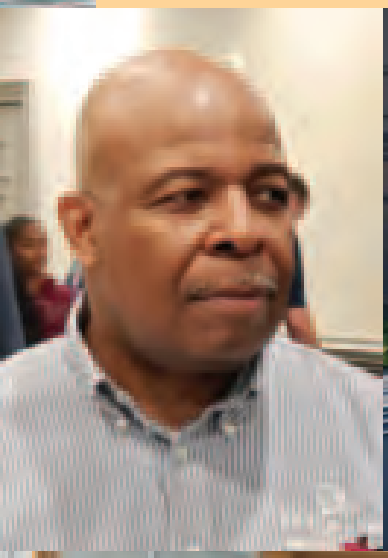

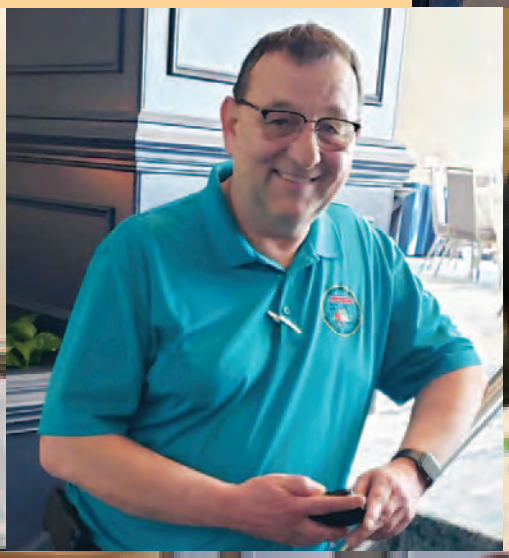

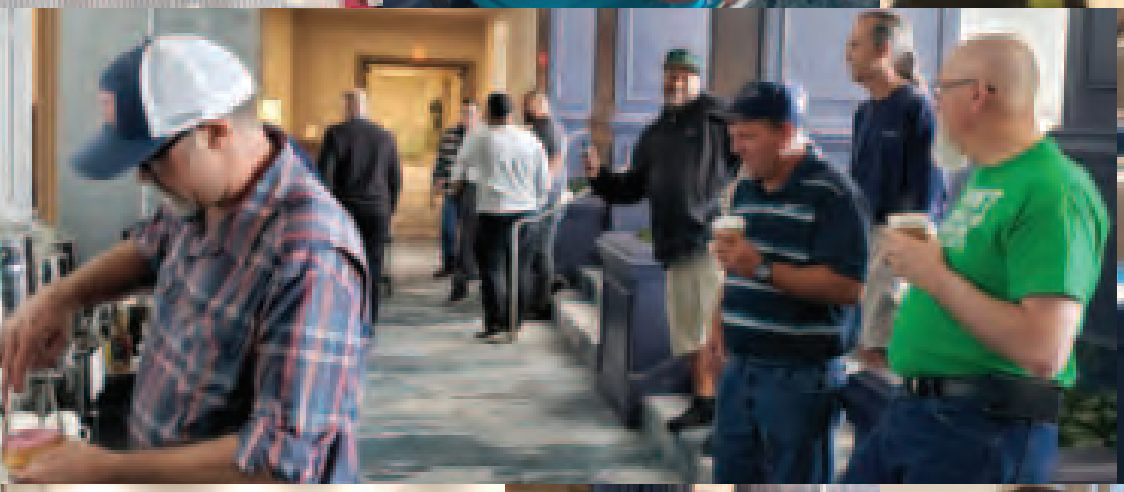

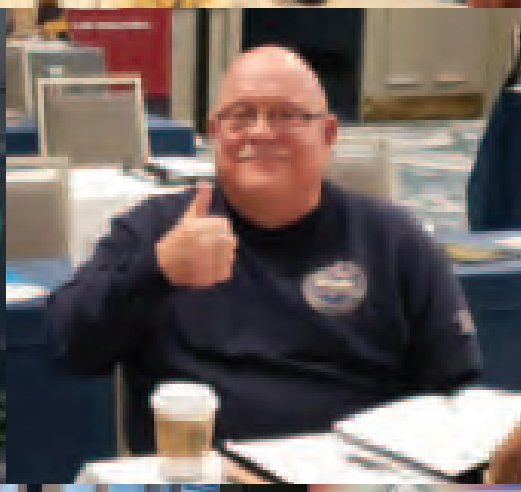

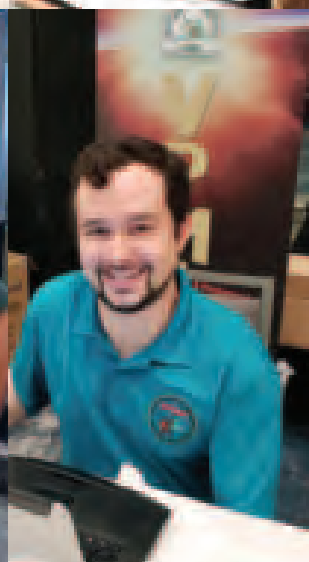

Virginia Energy Code 2018 IECC

IECC 2018 Energy Code

Piping Insulation Protection

IECC C403.2.10.1, R403.4.1 (2018): Piping insulation exposed to weather shall be protected from damage, including that due to sunlight, moisture, equipment maintenance, wind and shall provide shielding from solar radiation that can cause degradation of the material. **Adhesive tape shall not be permitted.**

Pipe-Insulation Ends Must Be Protected

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Exposure of Refrigerant Pipe Joints

1107.7 Refrigerant pipe joints erected on the premises shall be exposed for visual inspection prior to being covered or enclosed.

New Penetration Sealing Requirements

2018 IECC Commercial Energy Code

Air Barrier: New Penetration Sealing Requirement

R402.4.1.1 Shafts, penetrations - Utility penetrations of the air barrier shall be gasketed or otherwise sealed **and shall allow for expansion and contraction of materials and mechanical vibration.**

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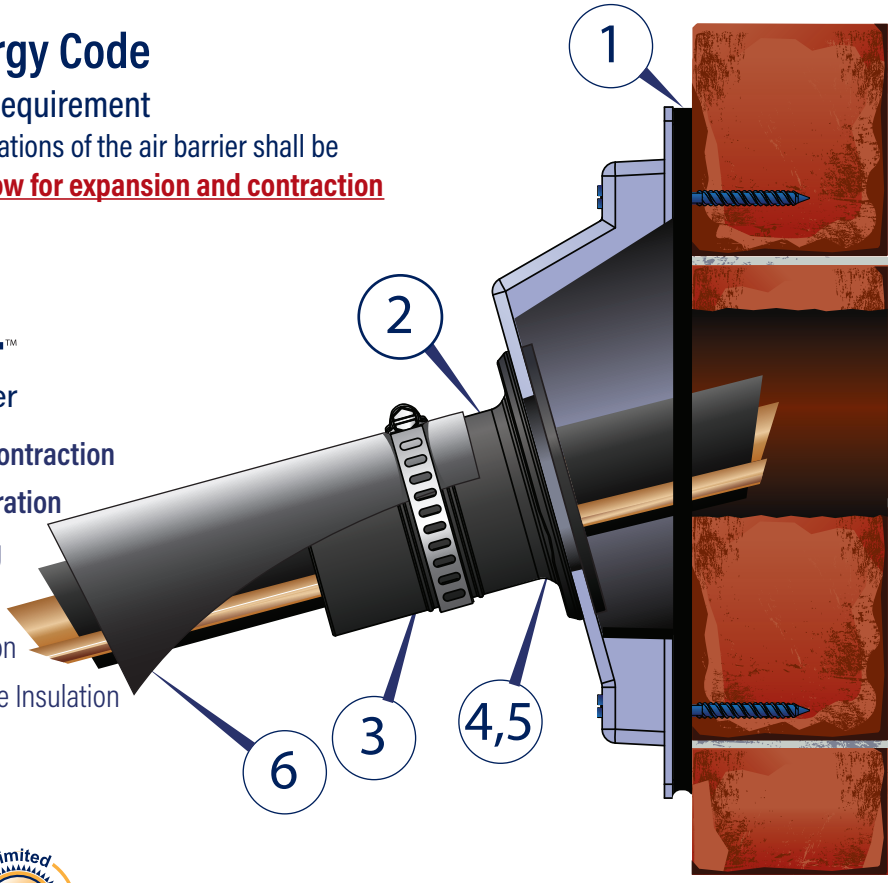

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Reviewing HVAC Designs

by Wes Davis

Building officials routinely require heating, ventilation and air conditioning (HVAC) system design information as part of the permitting process for commercial buildings, but some hesitate to request the same information for residential HVAC systems. As a reminder, the 2018 Virginia Residential Code (VRC) requires the following.

- Section M1401.3: "Heating and cooling equipment and appliances shall be sized in accordance with ACCA Manual S or other approved sizing methodologies based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies. Exception: Heating and cooling equipment and appliance sizing shall not be limited to the capacities determined in accordance with Manual S or other approved sizing methodologies where any of the following apply:
  1. The specified equipment or appliance utilizes multistage technology or variable refrigerant flow technology and the loads calculated in accordance with the approved heating and cooling methodology fall within the range of the manufacturer's published capacities for that equipment or appliance.
  2. The specified equipment or appliance manufacturer's published capacities cannot satisfy both the total and sensible heat gains calculated in accordance with the approved heating and cooling methodology, and the next larger standard size unit is specified.
  3. The specified equipment or appliance is the lowest capacity unit available from the specified manufacturer."
- Section 1601.1: "Duct systems serving heating, cooling and ventilation equipment shall be installed with the provisions of this section and ACCA Manual D, the appliance manufacturer's installation, or other approved methods.

From my experience, building officials do not require HVAC design information because they think it would take too long to properly review the load calculation and duct design, they may be concerned that they do not know what to look for and would not know how to address a contractor's challenges, or they may believe that air conditioning does not present a health or safety issue. The fact is that HVAC design or installation problems can affect a home's structural integrity and affect occupants' safety and health.

Comfort cooling has become standard equipment for most homes built today, and the building codes require that these systems be properly designed. Code officials are charged with enforcing this requirement and should therefore review the load calculation and duct design.

Load Calculation

If identical homes are built in Boston and Phoenix, the one in Boston will use more heating and the one in Phoenix will use more cooling. This may seem like an obvious consideration, but some HVAC system designers will use Phoenix's summer temperature to determine the cooling needs for the Boston home and Boston's winter temperature for the Phoenix home. They may seek to justify this by recalling a scorching Massachusetts summer and a long Arizona winter. However, rather than relying on isolated historic or anecdotal examples, building officials should make use of the high and low design temperature data that has been developed by scientific and engineering groups to 99 percent accuracy.[1]

For example, ACCA Manual J, Table 1A, gives the summer design temperature for Ft. Meyers, Florida, as 93°F. There will be some scorching July afternoons when the temperature rises even higher, but from year to year this will only occur 1 percent of the time. Meanwhile, the winter design temperature for Ames, Iowa, is -6°F. There will be some bone-chilling January nights when the mercury drops even further, but 99 percent of the year the weather will be warmer. Thanks to such highly accurate design temperature data, it is easy to examine a load calculation and determine if the designer used an "extreme" temperature. To return to our example, a building official in Ft. Meyers should look for a summer design temperature of 93°F and a winter design temperature of 47°F (Figure 1), and his or her counterpart in Ames should look for a winter design temperature of 6°F and a summer design temperature of 90°F (Figure 2). Anything outside of these ranges does not comply with the recognized procedure of ACCA Manual J prescribed by the 2018 VRC.

Indoor heating and cooling design temperatures that will satisfy most occupants are also available from ACCA[2]: 70°F for winter heating and 75°F for summer cooling.[3] Of course, the subjective indoor conditions provided for one homeowner may be too high or too low for another, but HVAC designers should carefully document the justification for choosing anything but these common design temperatures.

Basically, ACCA Manual J considers four factors: the temperature difference (indoor and outdoor), the ability

Worksheet A
Location and Design Conditions
Cobb Residence

State: Florida	**City:** Ft. Myers	**Elevation =** 15 Ft	**Latitude =** 26°
Indoor Conditions, Heating:	**DB =** 70 °F	**RH =**	**Indoor Conditions, Cooling:** **DB =** 75 °F **RH =** 50%
Table 1 Conditions	**99% DB =** 47 °F	**1% DB =** 93 °F	**Grains Difference =** 53 **Daily Range =** Medium
Design Temperature Differences		**HTD =** 70 - 47 = 23 °F	**CTD =** 93 - 75 = 18 °F

Figure 1. Ft. Meyers, Florida, ACCA residential design worksheet.

Worksheet A
Location and Design Conditions

State: Iowa	**City:** Ames	**Elevation =** 955 Ft	**Latitude =** 42 Degrees North
Indoor Conditions, Heating:	**DB =** 70 °F **RH =** 20%		**Indoor Conditions, Cooling:** **DB =** 75 °F **RH =** 50%
Table 1 Conditions	**99% DB =** -6 °F	**1% DB =** 90 °F	**Grains Difference =** 38 **Daily Range =** Medium
Design Temperature Differences		**HTD =** 70 - (-6) = 76 °F	**CTD =** 90 - 75 = 15 °F

Figure 2. Ames, Iowa, ACCA residential design worksheet.

of heat to pass through the various building components (walls, windows, doors, etc.), the area of the space conditioned, and moisture. The difference between the inside and outside temperatures is one of the basic considerations for proper load calculation. If the HVAC system designer began the process with the wrong design conditions, the resulting load calculation can be completely inaccurate. Other factors include design humidity, altitude, and latitude.

Equipment Selection

The next step in HVAC design review is to look at equipment selection. Load calculations produce the values, in British thermal units per hour (Btu/h), for selecting the equipment. The best place to find these values is in the original equipment manufacturer (OEM) performance data. Most OEMs provide performance data that rate their equipment at different operating conditions. For example, a 2.5-ton air conditioner may be rated at a slightly higher capacity in Seattle, Washington, because of the mild climate but at a lower capacity in Phoenix, Arizona, because the unit cannot produce as much cool air when it is 108°F outside (the ACCA 1-percent design temperature). Figure 3 uses a fictitious air conditioner model to illustrate a performance swing of 15 percent or more based on the operating conditions.

Duct Design

The evaluation of duct design is very subjective because of the wide varieties of layouts, fittings, etc. However, one aspect is very easy to evaluate: return air duct paths. ACCA Manual D, Section 4-9, states "An engineered, low resistance return path shall be provided for every room or space that receives supply air". In other words, larger rooms that usually have their doors closed, such as bedrooms and home offices, pose a need for air to get back to the air handler or furnace.

If a low-resistance return air path is not present, the air handler or furnace creates negative pressure inside the home. This negative pressure draws air from fire- places, the vent pipes for some furnaces and gas clothes dryers, and other fuel-burning appliances that use natural draft venting to carry away carbon monoxide (CO). As a result, the CO is not properly exhausted—posing a potentially serious health and safety risk. Reviewing the duct layout for large return grills in common areas and small return grills in rooms with normally closed doors can protect occupants from a back drafting appliance and CO pollution.

A ducted return is one solution; another is crossover ducts or transfer grills. Undercuts on doors are also acceptable but could require the removal of one or more inches, which may be aesthetically undesirable. The duct system layout illustrated in Figure 4 shows one large return for the

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	26,8		25,740	25,740
1000	72	35,250	19,090	33,680		32,030	17,890
	67	31,990	23,660	30,530	23,060	29,000	22,440
	63	29	220	28,020	26,560	26,770	26,770
	57	29,020	29,020	27,93			
1125	72	35,720	19,920	34,11			
	67	32,430	25,010	30,93			
	63	29,970	29,970	28,850			
	57	30,000	30,000	28,850	28,850	27,640	27,640

-15.7%

+16.9%

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.

Figure 3. Example air conditioner performance data.

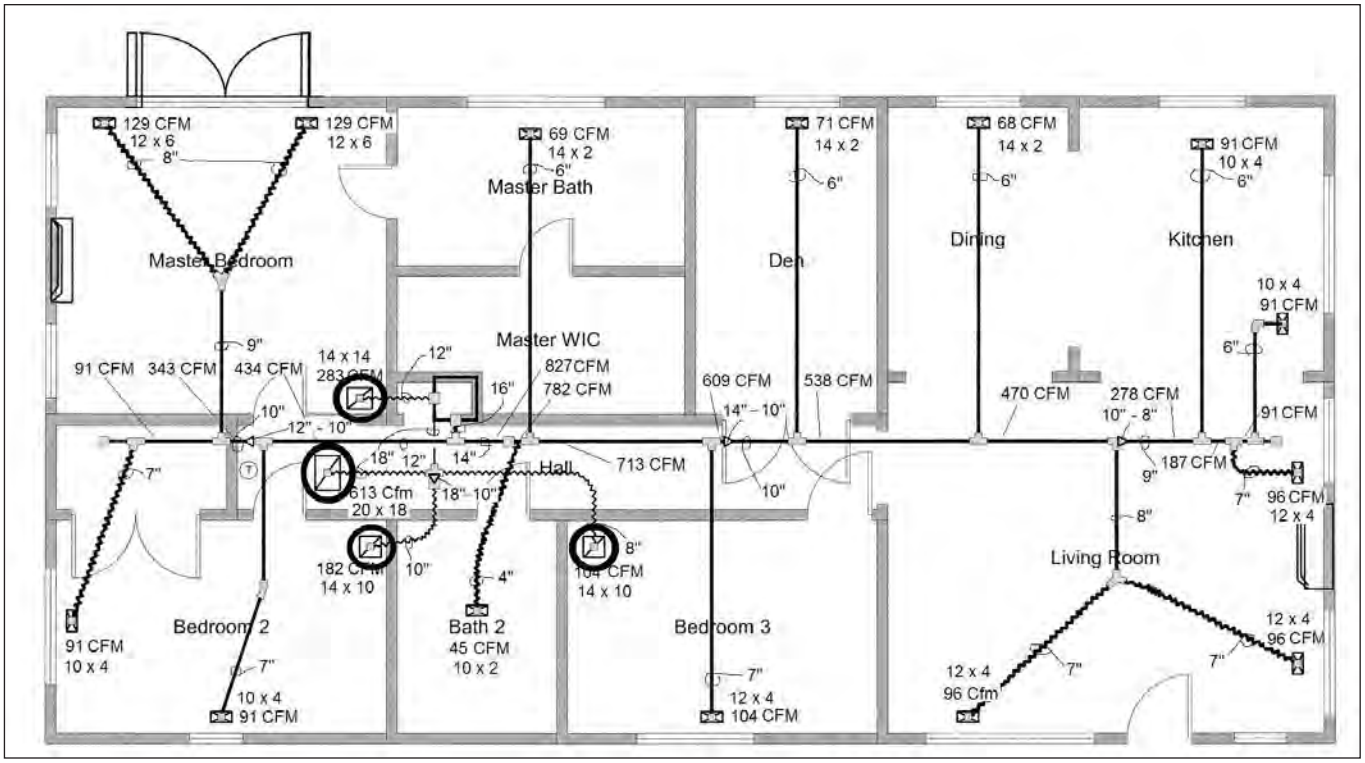

Figure 4. Example duct system layout.

open common living areas and a ducted return for each bedroom.

Reviewing a residential HVAC system takes some time but asking for the load calculation and duct design —and learning how to evaluate them—is relatively easy and contributes to protecting the health and safety of occupants.◆

Notes

1. **As illustrated in Figures 1 and 2, the winter design temperature is expressed as 99 percent and the summer design temperature is expressed as 1 percent.**
2. **These temperatures are the "sweet spots" identified by the American Society of Heating, Refrigerating and Air-Conditioning Engineers based on extensive research.**
3. **The designer has the option of selecting dry 45-percent relative humidity (Rh), normal 50-percent Rh or damp 55-percent Rh.**

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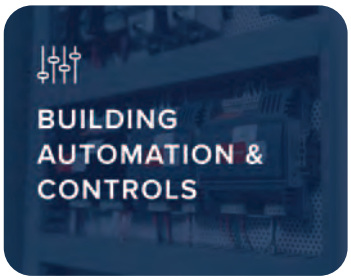

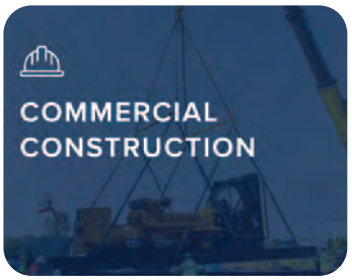

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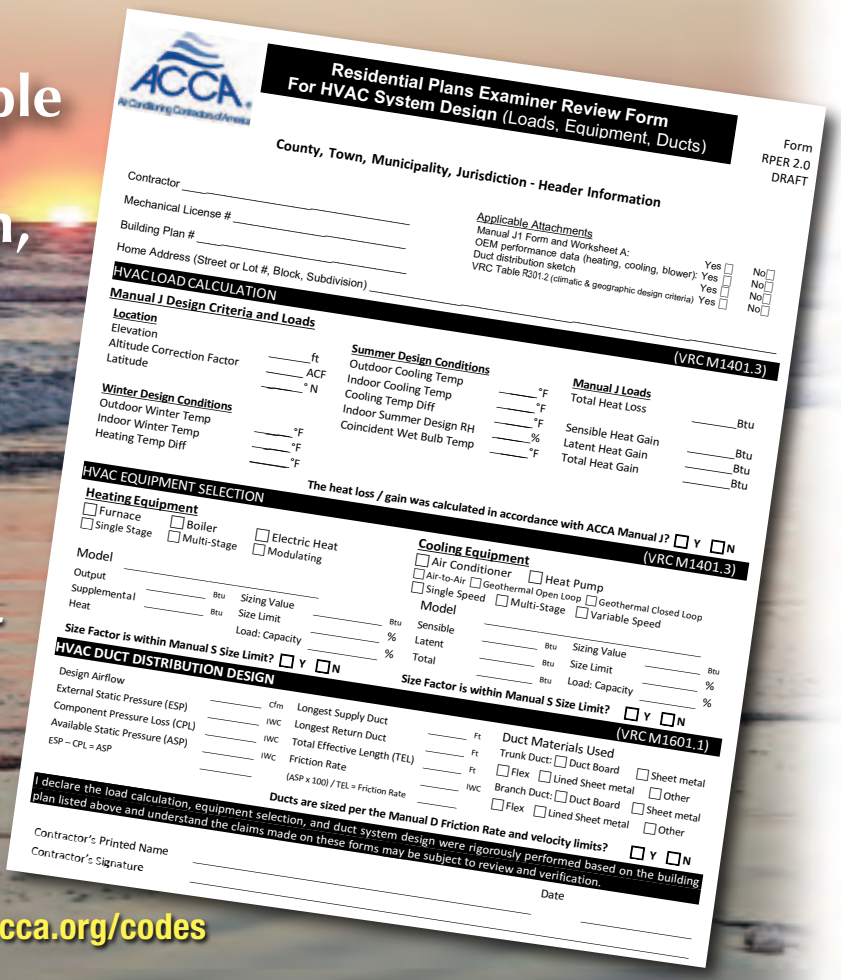
Residential Plans Examiner's HVAC Review Form

The information you need for a quick, simple evaluation of the HVAC system's design, all in one place.

ACCA developed this form to facilitate enforcement of the Virginia Residential Code by VPMIA members. It can be customized with your department's logo and is available for free download at: www.acca.org/codes



Residential Plans Examiner Review Form For HVAC System Design (Loads, Equipment, Ducts)

Form RPER 2.0 DRAFT

County, Town, Municipality, Jurisdiction - Header Information

Contractor
Mechanical License #
Building Plan #
Home Address (Street or Lot #, Block, Subdivision)

Applicable Attachments
Manual J1 Form and Worksheet A: Yes No
OEM performance data (heating, cooling, blower): Yes No
Duct distribution sketch Yes No
VRC Table R301.2 (climatic & geographic design criteria) Yes No

HVAC LOAD CALCULATION (VRC M1401.3)

Manual J Design Criteria and Loads

Location
Elevation
Altitude Correction Factor
Latitude

Winter Design Conditions
Outdoor Winter Temp
Indoor Winter Temp
Heating Temp Diff

Summer Design Conditions
Outdoor Cooling Temp
Indoor Cooling Temp
Cooling Temp Diff
Indoor Summer Design RH
Coincident Wet Bulb Temp

Manual J Loads
Total Heat Loss
Sensible Heat Gain
Latent Heat Gain
Total Heat Gain

The heat loss / gain was calculated in accordance with ACCA Manual J? Y N

HVAC EQUIPMENT SELECTION (VRC M1401.3)

Heating Equipment
Furnace Boiler Electric Heat
Single Stage Multi-Stage Modulating
Model
Output
Supplemental Heat
Sizing Value
Size Limit
Load: Capacity
Size Factor is within Manual S Size Limit? Y N

Cooling Equipment
Air Conditioner Heat Pump
Air-to-Air Geothermal Open Loop Geothermal Closed Loop
Single Speed Multi-Stage Variable Speed
Model
Sensible
Latent
Total
Sizing Value
Size Limit
Load: Capacity
Size Factor is within Manual S Size Limit? Y N

HVAC DUCT DISTRIBUTION DESIGN (VRC M1601.1)

Design Airflow
External Static Pressure (ESP)
Component Pressure Loss (CPL)
Available Static Pressure (ASP)
ESP – CPL = ASP
Longest Supply Duct
Longest Return Duct
Total Effective Length (TEL)
Friction Rate
(ASP x 100) / TEL = Friction Rate

Duct Materials Used
Trunk Duct: Duct Board Sheet metal Flex Lined Sheet metal Other
Branch Duct: Duct Board Sheet metal Flex Lined Sheet metal Other

Ducts are sized per the Manual D Friction Rate and velocity limits? Y N

I declare the load calculation, equipment selection, and duct system design were rigorously performed based on the building plan listed above and understand the claims made on these forms may be subject to review and verification.

Contractor's Printed Name
Contractor's Signature
Date

And check out these ACCA resources for code officials at **www.acca.org/codes**

- **Brochures addressing the verification of ACCA Manuals J (load calculations), D (duct sizing), and S (equipment selection)**
- **Three-part video series: What Code Officials Need to Know About HVAC System Design**
- **Bob's House, a residential HVAC design case study**

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