COMBINED HEATING SYSTEMS A Missed Opportunity?

ENERGY EFFICIENCY
ECONOMIC GROWTH
JOB CREATION
A CLEAN ENVIRONMENT
ENERGY INDEPENDENCE
HEALTH AND SAFETY



Applicable to New Construction



or Retrofit

Public Comment prepared by Robert Starr upon new rules proposed by The Vermont Plumbing Board

Summary

The Vermont Plumbing Board is proposing changes to the Vermont Plumbing Rules to become effective 7/1/04. This paper is public comment upon those changes.

The Vermont Plumbing Board proposes to adopt a Model Code by the International Code Council (ICC) but proposes to make certain changes in the Code. The ICC Code permits the use of domestic water heaters to make space heat as well as domestic hot water. The Board's changes would prohibit this use.

Robert Starr, a member of the public, offers testimony that the changes would prohibit highly efficient energy systems that are safe and beneficial to the public. Mr. Starr testifies that the Code should be adopted as planned by the ICC without changes.

Background

The Vermont Plumbing Rules became effective 11/1/96 and were based upon the BOCA National Plumbing Code 1990.

In 2003 the Building Officials and Code Administration, (BOCA) joined with the other major Code Councils including The Southern Building Code Congress International (SBCCI) and the International Building Code Congress International (ICBO) and the International Code Council (ICC) to develop one uniform organization called the International Code Council (ICC). <u>A goal of the consolidation was to eliminate the confusion</u>, redundancy and inefficiency of multiple code authorities.

The BOCA Code which formed the basis the Vermont Plumbing Rules has disappeared, and the BOCA organization has been integrated into the ICC.

The Board now proposes to adopt the ICC Codes with the significant exception that some highly energy efficient uses would be prohibited.

Section 501.2 of the International Plumbing Code, 2003, is as follows:

501.2 Water Heater as space heater. Where a combination potable water heating and space heating system requires water for space heating at temperatures higher than 140°F (60°C), a master thermostatic mixing valve complying with ASSE 1017 shall be provided to limit the water supplied to the potable hot water distribution system to a temperature of 140°F (60°C) or less. The potability of the water shall be maintained throughout the system.

The section clearly implies that such combination potable water heating and space heating systems can be safe and acceptable, and sets conditions.

The Vermont Plumbing Board, by its deletion of this section, deprives the public of the benefits of these combination systems without adequate basis.

"Combined Heating System" definition

For purposes of this discussion, <u>a Combined</u> <u>Heating System is one that uses the domestic</u> <u>water heater to produce both domestic hot water</u> <u>and space heating</u> by means of a heat exchanger from the water heater.

A Combined Heating System is often used with a low temperature heating application such as underfloor radiant heat.

SCHEMATIC DIAGRAM OF A COMBINED HEATING SYSTEM





Examples of the disallowed systems—(Appendix #1)

Appendix #1 presents some examples of systems that would not be allowed under the new rules. Reference is made to certain Combined Heating Systems that have been approved by ICC but would not be allowed under the new Vermont code. (Appendix #2) These are only some of the systems that would not be allowed. There are certainly others that have not yet been conceived of. One Combined Heating System (#4) uses a solar energy supplement that is practical in Vermont.

The Benefits of Energy Efficiency

A broad consensus exists that a reduction our fossil fuel consumption would be beneficial to all. The following benefits accrue when we meet our needs by using resources that are available within the State instead of using expensive foreign supplied fossil fuel resources.

- Less money could go out of the State economy.
- We could create more jobs within the state.
- We could have a better National security.
- We could generate more tax revenue.
- More money could be available to our schools as high quality renewable energy systems are subject to property taxes.
- Less pollution could be generated. Less acid rain could fall.
- There could be less global warming.
- More jobs could be available for the younger generation and more fossil fuel resources could be left for their use.

These benefits are not generally in dispute and we do not discuss them in detail here. What is not generally known, however, is the degree to which simple measures such as Combined Heating Systems can relieve Vermonters of the burden of fossil fuel consumption and the degree to which unreasonable bureaucratic burdens are preventing Vermonters from being more energy efficient.

A Technical Description of the energy efficiency benefits of Combined Heating Systems is provided in Appendix #3. The energy efficiency benefits are large. <u>Residential homes in Vermont could use almost no imported energy at all for space heating domestic hot water and space cooling if the State government will refrain from adopting rules that would disallow the measures. Combined heating systems can certainly be used with newly constructed homes, but equally important, they can often be applied to existing homes.</u>

Safety considerations — Safety advantages of combined systems are provided in Appendix #5.

The position of other Code bodies with respect to Combined Heating Systems.

Other Code bodies with significant evaluation resources have found that Combined Heating System can be safe.

The International Code Council has evaluated and accepted selected Combined Heating Systems. (Appendix #2)

The ICC is a code council that is the result of the consolidation of the former Building Officials and Code Administrators (BOCA), and The Southern Building Code Congress International (SBCCI) and the International Building Code Congress International (ICBO) and the International Code Council (ICC), all merged into one single member service organization, now, The International Code Council (ICC).

The ICC decision making process now holds the combined resources and wisdom of all of the above organizations.

The ICC decision making process now underlies the decision making process of most code authorities in the United States and is respected throughout the world.

They found that the reference Combined systems complies with or is a suitable alternate to that specified in the 2000 International Building Code, the 2000 International Residential Code for one and two Family Dwellings, the 2000 International Plumbing Code, the 2000 International Mechanical Code, the 2000 International fuel Gas Code, the 2000 International Energy Conservation Code, the 2000 ICC Electrical Code, the 2002 Accumulative Supplement to the International Codes, the BOCA National Building Code/1999, the 1999 Standard Building Code and the 1997 Uniform Building Code.

The Massachusetts Plumbing Board has recently accepted selected Combined Heating Systems (Appendix #4) The Massachusetts Board has the reputation of being one of the most conservative in the nation.

The Canadian Standards Association (CSA) has recently moved to accepted Combined Heating Systems.

The Argument for Combined Heating Systems

The public health and safety is of paramount concern in public rule making and all code bodies are conservative.

Nevertheless, the Department of Labor and Industries and the Vermont Plumbing Board cannot legally take actions that prevent the citizens from conserving energy IF THE MEASURES ARE SAFE.

Economic growth and job creation are important issues, as is the need to conserve our fossil fuels.

Certainly there is a very urgent need to become less dependent upon foreign energy sources.

No one disagrees that there is a need to protect the environment from the damage that the waste of fossil fuels creates.

All Vermonters will suffer as the price of fossil fuels goes up. As our energy dollars go out of state, jobs and economic opportunity will go with them. The poor will suffer the most.

The public wants to use measures to conserve energy. They have the right to do so under our founding principles if they are safe.

Article 18th of the Vermont Constitution is as follows:

Article 18th. [Regard to fundamental principles and virtues necessary to preserve liberty]

That frequent recurrence to fundamental principles, and a firm adherence to justice, moderation, temperance, industry, and frugality, are absolutely necessary to preserve the blessings of liberty, and keep government free; the people ought, therefore to pay particular attention to these points, in the choice of officers and representatives, and have a right, in a legal way, to exact a due and constant regard to them, from their legislators and magistrates, in making and executing such laws as are necessary for the good government of the State.

It is counter to our heritage and to our founding principles for our government to interfere with the citizens' effort to use energy frugally.

At the Board's suggestion, a thorough evaluation of specific Combined Heating Systems has been performed by experts at BOCA and ICC. <u>They were found to be safe.</u>

Other State Code bodies, with considerable resources have concluded that they are safe.

The Canadian Standards Association has concluded that they are safe.

In this context, the proposed rule making of the Vermont Plumbing Board lacks balance and goes too far.

The Vermont Plumbing Board has a duty to produce very sound and compelling reasons why it is moving to restrict the citizens' right to conserve energy. In my opinion, the Board has not done so.

Conclusion

International Code bodies and other state authorities have moved to permit these Combined Heating Systems because they are safe and because they offer significant public benefit.

The Vermont Board proposes to move in the opposite direction and prohibit these uses under all circumstances whether they are safe or not. It is regulatory extremism.

The Vermont Plumbing Board should adopt the 2003 International Plumbing Code as is, without the changes that it proposes.

Examples of energy systems that will not be allowed under the new Vermont Plumbing Rules.





The Indirect Heating System The domestic water heater provides space heating indirectly by means of a heat exchanger.





The Closed Heating System The domestic water heater provides space heating only with no attachment to the potable water at all. (not really a combined system)



Figure #3

The Open Direct Heating System The domestic water heater provides space heating to the building directly without an

intervening heat exchanger.





The Open Direct System with Solar Energy Supplement *The domestic water heater is supplemented with solar energy.*



Figure #5

Warm air system The domestic water heater provides heat to a warm air system by means of a fan coil.



LEGACY REPORT

NER-686

Issued October 1, 2003

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Legacy report on the 2000 International Building Code[®], the 2000 International Residential Code[®] for One and Two Family Dwellings, the 2000 International Plumbing Code[®], the 2000 International Mechanical Code[®], the 2000 International Fuel Gas Code[®], the 2000 International Energy Conservation Code[®], the 2000 ICC Electrical Code[™], the 2002 Accumulative Supplement to the International Codes[™], the BOCA[®] National Building Code/1999, the 1999 Standard Building Code[®], and the 1997 Uniform Building Code[™]

DIVISION 15 – MECHANICAL Section 15400 – Plumbing Fixtures and Equipment Section 15500 – Heating-Generation Equipment

CONCEPT OF A COMBINATION POTABLE WATER HEATING SYSTEM AND SPACE HEATING SYSTEM

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1.0 SUBJECT

Concept of using a combination potable water heater in a space heating system.

2.0 PROPERTY FOR WHICH EVALUATION IS SOUGHT

Concept of using a potable water heater for both potable water heating and space heating.

3.0 DESCRIPTION

GENERAL

Radiantec designs, procures specific components from others, installs and distributes closed, indirect, and open direct combination water heating and space heating systems. The systems include fixtures, piping, valves, controls, devices, heat exchangers and appliances which are designed and installed to provide hot potable water and hot water space heating. Water at a temperature above that desired for the space is pumped through a piping configuration, usually in the floor. Heat is transferred from the water in the piping system into the space.

Radiantec has three basic designs; an indirect system, a closed system and an open direct system. The indirect system provides both hot potable water and hydronic heating using a heat exchanger to keep the two loops separate (Figure 1). The closed system provides only space heating. In this design the water heater provides no potable water, and is used exclusively for hydronic heating (Figure 2). The open direct system provides both hot potable water and hydronic heating in a combination system which is also available in a supplemental solar energy design. The open direct system has a check valve which forces make up water entering the system to pass through the heating loop before entering the water heater. This prevents water from stagnating in the heating loop (Figures 3 and 4). Filling connections for the indirect system and the closed system shall be protected from flow from the hydronic piping loop.

Selected system components shall possess a current ICC-ES evaluation report indicating suitability as a component in a combined hydronic heating system and potable water system. This report excludes the sizing of the system, selection of individual components, and the systems ability to satisfy a specific hydronic or potable water heating demand.

4.0 INSTALLATION

Installation of Radiantec's closed, indirect, and open direct combination potable water heating and space heating systems referenced herein shall be in accordance with the requirements in the applicable code and the ICC-ES evaluation report that specifically evaluates each system component.

5.0 IDENTIFICATION

Each component of the closed, indirect, and open direct combination potable water heating and space heating system shall be identified in accordance with the requirements of the applicable code and the applicable ICC-ES evaluation report that specifically evaluates each system component. Upon completion of the installation, Radiantec shall provide a certificate of conformance for each installation.

6.0 EVIDENCE SUBMITTED

- 6.1 Radiantec Radiant Underfloor Heating Systems: Design and construction manual, dated 1997.
- 6.2 Concept diagrams of Radiantec's closed system, indirect system, and open direct potable water heating and space heating systems.

ICC-ES legacy reports are not to be construed as representing aesthetics or any other attributes not specifically addressed, nor are they to be construed as an endorsement of the subject of the report or a recommendation for its use. There is no warranty by ICC Evaluation Service, Inc., express or implied, as to any finding or other matter in this report, or as to any product covered by the report.



7.0 CONDITIONS OF USE

The ICC-ES Subcommittee for the National Evaluation Service finds that the concept of using a single water device to supply both potable water heating and space heating system as described in this report, complies with or is a suitable alternate to that specified in the 2000 International Building Code[®], the 2000 International Residential Code[®] for One and Two Family Dwellings, the 2000 International Plumbing Code[®], the 2000 International Mechanical Code[®], the 2000 International Fuel Gas Code[®], the 2000 International Energy Conservation Code[®], the 2000 International Energy Conservation Code[®], the 2000 ICC Electrical Code[™], the 2002 Accumulative Supplement to the International Codes[™], the BOCA[®] National Building Code/1999, the 1999 Standard Building Code[®], and the 1997 Uniform Building Code[™], subject to the following conditions:

- 7.1 Radiantec's closed, indirect, and an open direct combination potable water heating and space heating systems shall be designed and installed in accordance with Section 4.0 of this report and applicable provisions in the building, residential, plumbing, mechanical, electrical and energy conservation codes referenced herein.
- 7.2 The evaluation of the specific components of Radiantec's closed, indirect, and an open direct systems are outside the scope of this report.
- 7.3 Radiantec's design details and calculations for a closed, an indirect, or an open direct potable water heating and space heating system shall be furnished to the code official verifying compliance the applicable codes and the ICC-ES evaluation reports that specifically evaluate the applicable closed, indirect, or open direct combination

potable water heating and space heating system components. The details shall also address the ability of the system to serve all plumbing, mechanical, electrical and energy conservation demands, required by the applicable code and intended design. The individual preparing such documents shall possess the necessary credentials regarding competency and qualifications as required by the applicable code and professional registration laws of the state where the design and installation of a closed, an indirect, or an open direct combination potable water heating and space heating system are undertaken.

- 7.4 Radiantec's design details and calculations for the applicable closed, indirect, or open direct potable water heating and space heating system shall be available at the job site during and after construction. The details and calculations shall be stored in an identifiable, readily accessible and approved location.
- 7.5 The indirect system shall be installed to maintain fluid separation between the hydronic heating loop and the potable hot water system by using a heat exchanger.
- 7.6 Both the indirect system and the closed system shall be installed with the potable water connections protected from backflow from the hydronic heating system.
- 7.7 The open direct system shall be installed with a check valve to force make up water through the heating loop before entering the water heater.
- 7.8 This report is subject to periodic re-examination. For information on the current status of this report, contact the ICC-ES.



Figure #1 The Indirect Heating System



Figure #2 The Closed Heating System



Figure #3 The Open Direct Heating System



Figure #4 The Open Direct System with Solar Energy Supplement

A TECHNICAL DESCRIPTION of the energy saving potential of Combined Heating Systems. (and the associated reductions in air pollution)

The energy saving potential of Combined Heating Systems is largely due to the <u>COMBINATION</u> of these four factors

- 1. Condensation of the flue gasses
- 2. Affordability of a high efficiency unit
- 3. Reduction of standby losses
- 4. Compatibility with alternative energy

CONDENSATION of the flue gasses

Our fossil fuel reserves are compounds made of hydrogen and carbon (hydrocarbons). Often a small amount of sulfur is present.

When we burn a hydrocarbon for it energy, the chemical reaction produces:

- 1. Carbon dioxide (a greenhouse gas)
- 2. Water (in the form of steam)
- 3. Some sulfur dioxide (a component of acid rain)
- 4. Some nitrous oxide (another component of acid rain)

HYDROCARBONS + OXYGEN = CARBON DIOXIDE + STEAM + SULFURIC ACID + NITRIC ACID

If we can condense the steam to water, we can achieve the highest possible efficiency. Modern domestic water heaters can achieve this condensation in a simple manner because they operate at relatively low temperatures as compared to a boiler.

Equally important, the acid rain components will dissolve in the water where they can be drained away harmlessly. Even some of the carbon dioxide will be dissolved and drained.

Modern domestic water heaters operate at the highest possible efficiency and produce the least amount of pollution.



Affordability

Most Vermonters must place heavy emphasis on initial affordability. For the poor, the first cost is critical. The additional cost of a highly efficient heating unit is easily justified if it can perform two functions. The *combination* of energy uses makes a higher efficiency appliance affordable.

Standby losses

Most heating units lose energy when they are "standing by", ready to perform their function but not actually doing it. With inexpensive units, standby losses can amount to 35% of the energy cost or more. When one unit performs two functions, one set of standby losses is eliminated and the combination unit will standby less.

Compatibility with alternative energy

Domestic water heaters with solar assist are a proven technology with demonstrated cost effectiveness. If space heating is done with the water heater, a solar heating percentage of 35% is achievable with conventional building methods.

Compatibility with radiant heat

Underfloor radiant heat is ideal with moderate heating sources such as a domestic water heater. Radiant heat offers comfort advantages and reduces energy costs by 25-35%

A *combination* of these energy saving measures will reduce fossil fuel consumption to a small fraction of what it would otherwise be.

It is the *combination* of energy uses that makes the energy saving measures practical. The new rules of the Vermont Plumbing Board will mean that Vermonters will be allowed none of them.





HEATING EFFICIENCY OF A MODERN CONDENSING WATER HEATER



THIS IS A 41% REDUCTION IN FOSSIL FUEL USE OVER THE NEXT BEST CASE.



SAFETY CONSIDERATIONS

The previously mentioned code bodies, the ICC, the Massachusetts Plumbing Board and the CSA and others have studied Combined heating systems and found that they can be done safely.

Combined systems can and probably should be regulated such that so called "dead ends" will not occur. A dead end is a length of tubing that does not flow in normal use. The above code bodies have all regulated Combined systems to that effect. Standard good plumbing practices can eliminate whatever hazard could arise from "dead ends". The possibility of a plumbing "dead end" can not be used as a pretext to deny Combined Heating Systems outright.

In Vermont, there are many thousands of water systems that stand utterly stagnant for months at a time. These include condominiums, student apartments, seasonal resorts, lakeside resorts, hunting camps, etc.

It is also worth noting that so called recirculating systems are mechanically identical to Combined Heating Systems in that domestic water is circulated throughout a loop of tubing in order to provide prompt access to the domestic hot water.



Recirculating systems are commonly approved in public buildings throughout the state.

It is notable that Combined Heating Systems are no longer novel. These systems came into use following the first energy shocks n the 1970's when buildings became significantly more energy efficient.

There are more than 100,000 Combined heating systems in the United States and Canada.

Legionnaire's disease and other waterborne illnesses are reportable on a mandatory basis in all states of the United States and in all provinces of Canada. If these systems were generating pathology, we should know about it by now.

No heating system is completely without problems. That said, Combined systems offer many safety advantages and are <u>at least as safe as the systems that we are accustomed to, and in many respects, even more so.</u>

Here are the safety advantages.

- Low temperature Low temperatures mean that it is possible to touch any exposed surface of the referenced Combined Heating System without harm.
- 2. Fire safety Low temperatures result in improved fire safety.
- 3. Simplicity A combined system means that there is one less system to malfunction. Greater reliability is to be expected.
- 4. Pasteurization Water that is consumed from the Combined Heating System must first pass through the domestic water tank before it is used. The tank temperature is kept at elevated temperatures in order to provide heating. The water is arguably safer to use than the cold.
- 5. Still air Combined heating systems that use underfloor radiant heat do not circulate warm air throughout the building. Dirt, dust, bacteria, viruses, allergens and pet dander are not circulated either. Humidity is maintained at more healthful levels.

The following method enhances the safety of Combined Heating Systems by preventing stagnation of potable water in the heating coil whenever the building is occupied.

The method prevents stagnation of the water in the heating coil during the summer.

It is a "passive" method that has no mechanical or electrical components.



OPEN/DIRECT HEATING SYSTEM

OPEN/DIRECT HEATING SYSTEM