# ISO STANDARDS UPDATE

Mark Menzer, Vice President, Engineering and Research, and James Walters, Director, International Standards of the Air-Conditioning and Refrigeration Institute, (ARI), Arlington, Virginia, USA

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**Abstract:** The Air-Conditioning and Refrigeration Institute (ARI), a North American developer of HVAC&R standards and certification programs, is a globally oriented organization because its members operate in virtually every part of the world. Although ARI's standards are used globally, ARI is committed to international standardization and to working with global standards organizations such as the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). ARI's standardization and certification programs are integral to U.S. energy efficiency efforts in the HVAC&R industry and are increasingly in demand in South America, Asia and Europe. If current standards discussions in ISO regarding energy efficiency calculations are resolved in favor of the adoption of Seasonal Energy Efficiency Ratio (SEER) the resulting standards will more adequately address market forces, increase manufacturers' global competitiveness, and provide a sound technical basis for governmental energy policy.

## Introduction:

Discussing standards and standardization issues carries the danger of appearing to miss the point of everyday life needs—safety, health, environmental stewardship, economic progress, prosperity and a higher quality of life. Standards experts and their process of developing standards are often viewed by the uninvolved as separate and apart from real world needs and applications. However, standardization *is* about dreams, goals and people, about sharing and transferring technology, about saving energy, sustaining development and improving life. The heating, ventilation, air-conditioning and refrigeration (HVAC&R) industry attempt to do all these things through its standardization programs in a number of organizations, including but not limited to the International Organization for Standardization (ISO), and the International Electrotechnical Commission (IEC). The elements of effective standardization in the HVAC&R industry are timeliness, quick response to market forces, respect for the need for energy efficiency, an open, global and transparent development process, open to all, not just nation-states, environmental stewardship and the use of any standardization organization that can meet those elements.

## Main Body

### 1. ARI – AN INTERNATIONAL STANDARDS PARTICIPANT

The Air-Conditioning and Refrigeration Institute (ARI) is a North American industry trade association located Arlington, Virginia, just outside of Washington, D.C. It is a private, not-for-profit organization composed of over 200 manufacturers of heating and air-conditioning equipment and refrigeration. Its members

manufacture 90% of HVAC&R equipment in North America. ARI is a full service trade association having a standards and certification program, providing international trade assistance to its members, engaging in governmental and public relations, conducting educational and training courses for industry technicians, collecting and publishing statistics and managing a research program.

Although located in North America, ARI is an organization with global interests and activities because its members have those interests. ARI member exports outside of North America total over $6 billion annually and many of them produce equipment in other countries singly or in joint ventures. Globalization is an HVAC&R byword and, as a member-driven organization, ARI reflects that fact.

The core of ARI's technical and engineering efforts is its standardization program, which is based on more than 70 standards and guidelines. This program has existed since the early 1950's and is robust and expanding. Generally, ARI standards fall into four categories:

- **Performance Rating Standards** that characterize product performance in such terms as capacity and efficiency for use by third parties in specifications, literature and advertising;
- **Application Standards** that use measurements in conjunction with a rating standard to provide results at conditions different from rating standards;
- **Technical Guidelines** that are instructional documents which address such things as terminology, equipment specification, procedures, or application;
- **Methods of Testing Standards** that set forth procedures for measuring capacity or other aspects of operation, together with a specification of instrumentation, procedure and calculation of results. This latter type of standard is used in conjunction with Method of Test Standards written by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE). This linkage between ARI and ASHRAE is an important one and will be discussed later in the context of international standards

By 2003 it is projected that the program will have 85 standards and guidelines. The ARI standards program emphasizes technical and engineering integrity and timeliness. It draws from the experience and research of its members and a process intended to provide incentives for new ideas and consensus. Its standards not only establish rating criteria and procedures for measuring product performance; they also are the basis for ARI's 23 product certification programs.

Industry product sections committees, composed of ARI members, develop and maintain ARI's standards. The product sections are responsible for initiating and completing new domestic and international standards and maintaining existing ones. Each product section is comprised of members that manufacture a particular product or related products. The chairs of these sections are members of ARI's Board of Directors, thus creating a direct link between standards development and ARI governance.

Many of ARI's standards have been what may be called de facto international standards. That is, they were and are preferred and used in applications around the

world. ARI encourages the use of its standards globally and has agreements with several countries to allow ARI standards to be used as a basis for the development of national standards.

ARI's pursues its global commitment by working with several international groups. It is a member of the International Council of Air-Conditioning and Refrigeration Manufacturer's Associations (ICARMA). This group of associations from the United States, Japan, Canada, China and Europe is a forum for discussing issues affecting the global HVAC&R industry. ARI also liaises with The European Partnership for Energy and the Environment (EPEE), an organization that contributes to the development of effective European policies to reduce greenhouse gas emissions from the use of refrigerants. Working with these groups enriches ARI's standardization development process by keeping ARI's members aware of industrial, environmental and regulatory issues outside North America.

## 2. CERTIFICATION PROGRAM

ARI's standardization program is the basis for ARI's global certification program, a private, voluntary program that benefits industry, consumers and government. The program is open to ARI member and non-member manufacturers, North American or foreign. ARI's first certification program in 1959 was for unitary air-conditioners. It had 30 participants and 19 pages of directory listing weighing 1.3 ounces. Today, ARI administers more than 23 different equipment certification programs with almost 100 participants in the Unitary Air-Conditioners Program alone, and the directory for that program now weights almost 2Kg with 1500 pages of listings. As noted elsewhere, it is also available on the web at www.ariprimenet.org.

ARI's certification program is industry developed, driven and managed. It is voluntary and private, not the result of a governmental mandate. Its value derives from marketplace recognition of its Certification Mark. ARI members recognize that a program that provides a sound engineering basis for rating the efficiency of HVAC&R equipment benefits manufacturers and consumers. It allows product comparison and provides incentive to manufacturers to improve efficiency in order to gain market share. The program is also a vital component of an industry-government partnership, discussed subsequently, to increase energy efficiency, a model for other countries to use and the source of data for developing international standards.


ARI's certification program changes to meet societal and market requirements. In response to the pending phase-out of CFC's and HCFC's in the 1990's, ARI developed certification programs to certify equipment that will recover and recycle refrigerants. The certification of refrigerant purity, the ARI 700 Certification Program, opened a new chapter in ARI certification. The program recognized the detrimental effect of impure recycled refrigerants and established a program to certify the purity of reclaimed refrigerants.

ARI's certification program is global. It easily incorporates relevant ISO standards e.g., ISO 13256, dealing with water source heat pumps. It is in full

compliance with Canada's Energy Efficiency Regulations, accredited by the Standards Council of Canada (SCC) to ISO Guide 65 and recognized by the Natural Resources Canada (NRCAN). ARI's contract test laboratories are also accredited to ISO 65. In January 2000 ARI launched its 50Hz program in liquid chillers in response to demand from Asia. This program led to a Mutual Recognition Agreement (MRA) with a European certification organization, EUROVENT-CECOMAF. Additionally, ARI will assist India, Brazil, Saudi Arabia and the Gulf States in establishing equipment certification programs. These requests come from markets where unsubstantiated claims of equipment efficiency thwart educated consumer choices and government efforts to promote energy efficiency, and may have negative environmental consequences.

## 3. ARI RESEARCH

ARI's technical and scientific efforts include scientific research undertaken in the public interest. In 1989 ARI established a research organization, The Air-Conditioning and Refrigeration Technology Institute (ARTI) to conduct pre-competitive research on refrigerant properties, material compatibility and energy efficiency. Since 1989, ARTI has managed over $20m in research. Currently there are 39 projects underway in the areas of alternative equipment, equipment energy efficiency, system integration, indoor environmental air quality and working fluids. This body of research provides an important resource touchstone for the HVAC&R industry, as well as a forward looking focus to ensure that industry's engineering efforts keep up with changing manufacturing and societal needs. More information is available from the website, www.arti-21cr.org, which is part of the ARI website, www.ari.org.

## 4. ARI STANDARDS AND ENERGY EFFICIENCY – BASIS FOR INDUSTRY/GOVERNMENT PARTNERSHIP

The United States is a major user of energy **(Figure 1).** According to the U.S. Department of Energy the U.S. energy consumption in 1999 was 97 Quads (one quadrillion BTU's) and is projected to increase by more than 25% by 2020.

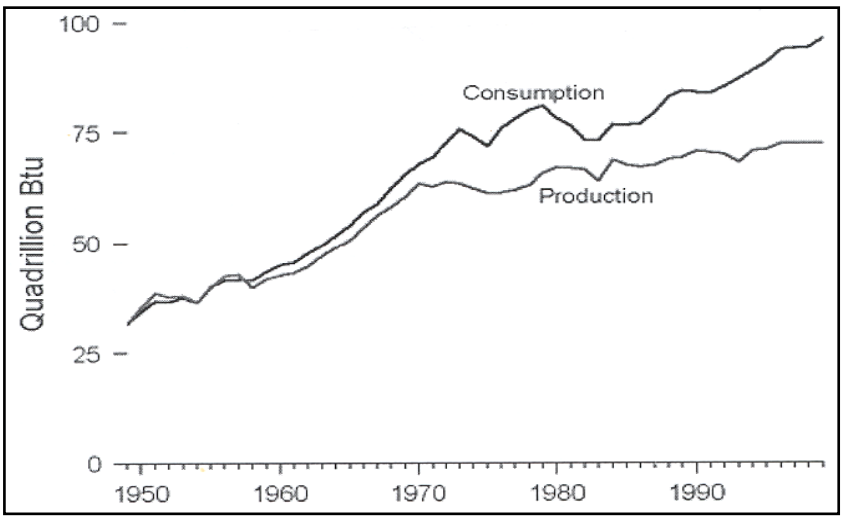
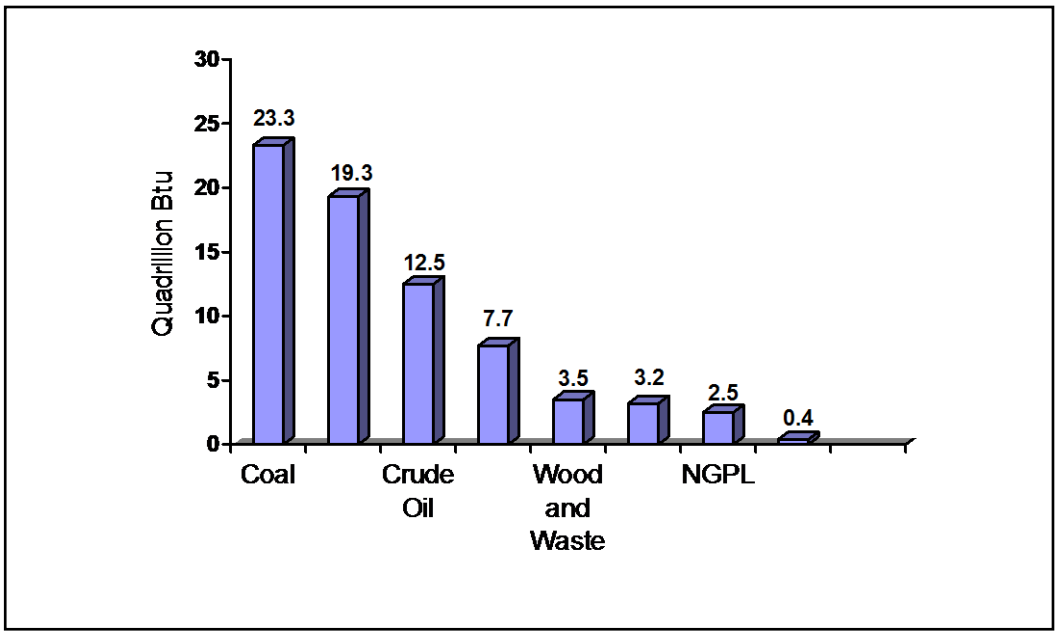



Figure 1. U.S. Energy Production and Consumption

Energy efficiency is an U.S. goal for a number of reasons. First, the U.S. recognizes the economic value of greater efficiency to reduce energy costs. Second,

although the Bush Administration has withdrawn support for the Kyoto Protocol, the U.S. wishes to advance its stewardship of the environment. Fifty-five per cent of U.S. energy needs are met with fossil fuels—a dependency that can be reduced in part through energy efficiency. (**Figure 2).**

Figure 2. U.S. Energy Production by Fuel




In response to the need to increase energy efficiency, ARI and the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) have worked in partnership with the U.S. Government (USG) to develop minimum energy standards and provide manufacturers with incentive to produce better equipment Two USG laws set these standards for HVACR equipment. First are the National Appliance Energy Conservation Act of 1987 (NAECA) and the U.S. Energy Policy act of 1992 (EPACT). NAECA applies to residential products including air-conditioners and heat pumps and sets efficiency levels Seasonal Energy Efficiency Ratio (SEER) and Heating Seasonal Performance Factor (HSPF) requires consumer labeling and provides for enforcement. EPACT applies to commercial heating and cooling equipment and sets efficiency levels. The law directs the U.S. Department of Energy (DOE) to consider adopting ASHRAE 90.1(Energy Standard for Buildings Except Low-Rise Residential Buildings) and it references ARI test procedures. It further requires energy efficiency labeling and advertising of efficiency and testing by manufacturers to determine efficiency. . Presently, the USG, with industry support, has proposed raising the minimum SEER and HSPF for split air-conditioners and heat pumps from 10 SEER/6.8 HSPF to 12 SEER/7.4 HSPF and from 9.7 SEER/6.6 HSPF to 12 SEER/7.4 HSPF for packaged air-conditioners and heat pumps.

In this partnership, ARI provides the testing performance standards for equipment, ASHRAE provides the test method and, with USG oversight, energy efficiency levels. ARI and ASHRAE standards then are the basis for verifying manufacturers' equipment efficiency claims through independent laboratory testing in ARI's Certification program, described above. Private, voluntary standards, government oversight, and verification in an industry test program come together to

achieve national energy efficiency goals by increasing minimum energy efficiency standards.

It is worth noting, in fact, that a current proposal is for the DOE to waive government testing if the equipment has been certified by ARI's Certification program.

In the context of discussing the government-industry partnership it is instructive to review the migration of U.S. energy efficiency policy from using EER, Energy Efficiency Ratio to using SEER, Seasonal Energy Efficiency Ratio. Prior to 1978 and in the absence of governmental regulation, EER, measuring steady-state efficiency at one condition, was the norm. Utility companies, eager to offer rebates to reduce electrical use, needed a more realistic energy use model than EER which was not representative of seasonal usage and on/off cycling losses.

In response, the DOE in late 1979 proposed SEER, based on work by the U.S. National Institute of Standards and Technology (then known as the National Bureau of Standards). The new approach provided a better metric for energy use because it recognized on/off cycle losses, allowed energy consumption measurement in 5 degree F (2.4 degrees C) outdoor temperature increments (Bins), was weighted by hours of operation and used either national or regional weather data. In heat pumps, using HSFP provides for the recognition of frost/defrost loss and auxiliary heat requirements. Subsequently, ARI modified its standard to allow testing to establish the SEER and HSFP rating.

The lesson of these developments is a case study in government-industry cooperation to address a common need—better measurement of energy usage by more accurately establishing equipment ratings. A market-driven desire to better measure energy usage led to government research and subsequently, to the adoption by industry, in its standards, and by government, in its laws and regulations, of a more efficient energy measurements. It was recognized that, in order to perform the calculation of SEER, it would require a bit more testing. However, the desire to have a more realistic performance metric outweighed the additional testing. The market-effect of this change was positive. Using SEER allowed clearer comparisons among competing energy efficiency claims because the SEER rating identifies top energy efficiency performers. This in turn resulted in incentives for manufacturers to produce better equipment and give consumers a more informed choice of equipment.

## 5. ARI's INTERNATIONAL STANDARDS PROGRAM AND THE INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ARI's international standards program is grounded on its standardization and certification programs that are already global in application. One avenue that ARI has chosen as a vehicle for participation in international standards activity is ISO.

In 1990 ARI's Board of Directors endorsed the following policy…

*That ARI adopt a long-range strategy to move towards eventual adoption of international (ISO and IEC) standards….*

Adopting this policy signaled several ARI goals. One was to actively participate in both ISO and the International Electrotechnical Commission (IEC). Second, the Board identified these two organizations as important, but not exclusive, arenas in which global standards could be developed. Third, the Board recognized that a global organization, such as ARI, with globally focused members needed to concentrate on standardization as a way to facilitate trade by eliminating technical barriers to trade. In this sense the Board policy was not so much breaking new ground as formally recognizing ARI's already existing international role—one that the Board hoped would grow.

Founded in 1947, ISO is a private, national government dominated (70% of the members bodies are government representatives) federation of national standards bodies that develops standards for the purpose of facilitating international trade. There are 138 member bodies. There are 36 Corresponding Members i.e., countries who do not have a fully developed national standards system but who wish to be kept informed if ISO work. There is a third category, Subscriber Members, whose economies are still developing but who pay a reduced fee to keep abreast of ISO work. [Note: The fact that the initials ISO do not correspond to the organization's name stems from the fact that ISO declared that "ISO", from the Greek word for 'equals", ISOS, would be the official acronym].

Technical work in ISO is organized by technical committees which are numbered (e.g., TC 86, Refrigeration and Air Conditioning) and composed of ISO member bodies. These TC's are typically organized into Subcommittees (SC's) that deal with some subset of the overall TC scope and further reduced to Working Groups (WG's) that draft standards. There are approximately 175 ISO technical committees.

The focus of ARI's ISO work is TC 86, Refrigeration and Air-Conditioning. TC 86 has 21 Participating Members and 34 Observer Members. Participating members develop and vote on standards. The scope of the TC is broad:

***Standardization in the fields of refrigeration and air-conditioning, including terminology, mechanical safety, methods of testing and rating equipment, measurement of sound levels, refrigerant and refrigeration lubricant chemistry, with consideration given to environmental protection. The scope includes factory-assembled air-conditioners (cooling), heat pumps, dehumidifiers, refrigerants, and refrigerant reclaiming and recycling equipment as well as other devices, components and equipment such as humidifiers, ventilation equipment and automatic controls used in air-conditioning and refrigeration systems that are not covered by other ISO technical committees.***

The 21 Participating Members of TC 86 are: Spain, France, Romania, Bulgaria, United Kingdom, Germany, Denmark, Russian Federation, Iran, Jamaica, Japan, Netherlands, Poland, Australia, Finland, Sweden, Switzerland, Slovakia, Turkey and Italy and the United States.

The work of TC 86 is organized as shown below.

| Committee | Secretariat |
|---|---|
| **TC 86, Refrigeration and Air-Conditioning** | ANSI (ASHRAE) |
| SC 1, Safety of Refrigeration Systems | ANSI (ASHRAE) |
| SC 2, Terms and Definitions | ANSI (ASHRAE) |
| SC 3, Testing and rating of | |

| | |
|---|---|
| factory-made refrigeration systems | ANSI (ARI) |
| SC 4, Testing and rating of refrigerant compressors | BSI (UK) |
| SC 5, Testing and rating of household refrigeration appliances | UNI (Italy) |
| SC 6, Testing and rating of air-conditioners and heat pumps | ANSI (ARI) |
| SC 7, Testing and rating of commercial refrigerated display cabinets | BSI (UK) |
| SC 8, Refrigerants and refrigeration lubricants | ANSI (ASHRAE) |

ARI's serves as Secretariat of two TC 86 subcommittees. Administratively, ARI chairs the United States Technical Advisory Group (TAG) for which ASHRAE is the Secretary. This group of experts is the U.S. forum for reviewing ISO policy issues and technical standards issues to form the U.S. position for work in all of TC 86's subcommittees. In addition, ARI and ASHRAE combine their standards when proposing new work to TC 86. ASHRAE and ARI standards are complementary—ASHRAE produces the method of test and ARI the testing procedure for rating equipment performance. Additional coordination is achieved by industry cross-membership on the technical committees of both organizations. **Figure 4** shows the standards development path, including ASHRAE's role, in the development of international standards proposals from ARI and ASHRAE.

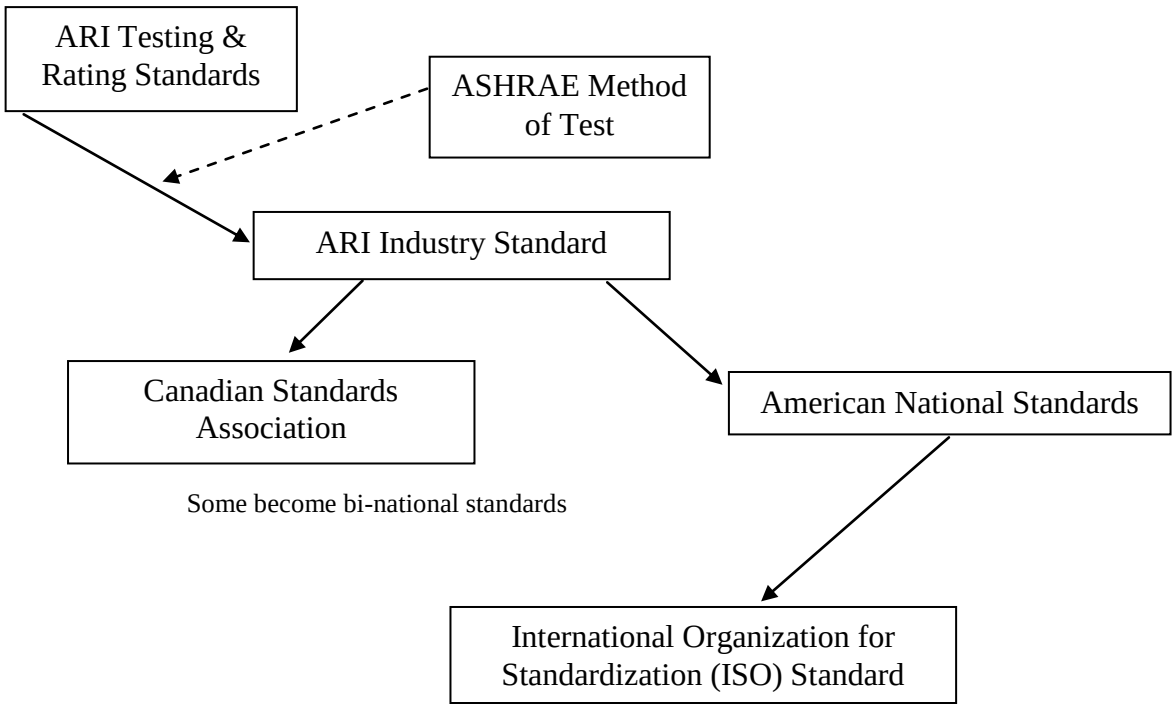



Figure 4. How an ARI Standard Evolves to Become an ISO Standard.

ARI is making progress on its commitment to adopt international standards. To date, ARI and ASHRAE have adopted two ISO standards, ISO 13256-1 Water-to-Air and Brine-to-Air Heat Pumps—Testing and Rating for Performance and ISO 13256-2, Water-to-Water and Brine-to-Water Heat Pumps—Testing and Rating for Performance and is reviewing two Sound Rating standards, ISO 13261-1 and 13261-3

for adoption. ARI continues to work within ISO to develop standards and it will continue to adopt them, although perhaps with national amendments as the need arises. National amendments are additional information or clarifications to an ISO standard, approved by a country's national standards body that allows for a deviation in the standard to meet unique national regulatory or operational needs.

Although this paper deals primarily with ISO, mention of work in the HVAC&R area by the IEC is necessary. The IEC is a national standards body based organization, similar to ISO, and also headquartered in Geneva. (See Website www.IEC.ch) IEC is the international standards and conformity assessment body for all fields of electrotechnology. IEC standards typically deal with electrical safety issues. Its Subcommittee 61D, Appliances for Air-Conditioning for Household and Similar Appliances, addresses issues of interest to the HVAC&R industry. An example of such an issue is the size of charge of flammable refrigerants allowed in home appliances.

## 6. INTERNATIONAL STANDARDIZATION ISSUES—DEVELOPING THE BEST STANDARDS AND GETTING THE JOB DONE

ISO is one arena where at least two major issues are being considered: energy efficiency and resource allocation to get the job done.

The debate on energy efficiency is often very technically detailed and buttressed by pages of proposals and counter-proposals. The technical discussions of the merits of EER and SEER, which previously took place in the U.S., are now being held globally. Most ISO HVAC&R performance standards use steady state EER metrics. However, the value of SEER, which better reflects energy use and year round efficiency is being considered. ISO should move to adopt of a SEER patterned after the US DOE model because it more closely approximates real world conditions. Admittedly, testing to establish EER is less expensive than to establish SEER because fewer data points are taken. However, EER does not account for the fact that the system operates at steady state for only a few operating hours. For example, in the United States and presumably elsewhere, less than 5% of cooling season hours are at more than 95 F ambient and more than 70% cooling season hours are less than 82 F ambient , at which point the system cycles on/off. EER does not reflect on/off losses. EER therefore does not credit better engineering and energy saving devices. SEER, developed at an incrementally higher cost yields savings that far exceed testing costs, and rewards innovative engineering—and we want to encourage innovation in ISO standards so that they are competitive and useful.

These detailed technical issues are at the center of an appropriate exchange for developing standards. However, this detail should not obscure larger issues that are at stake. We in ISO are challenged by technical issues that have economic and environmental consequences. We need to ensure that technical experts operate in an environment where they are aware of larger societal and environmental goals. ISO's HVAC&R standards will be successfully used not because they are from ISO, but because they are effective tools for meeting market requirements and global issues of environmental stewardship and sustainable development. As mentioned above, two ISO standards, 5151 (Non-ducted air conditioners and heat pumps – Testing and rates for performance) and 13253 (Ducted air-conditioners and air-to-air heat pumps –

Testing and rating for performance) are under revision. As currently written these two standards do not fully address a SEER solution. The proposed revisions do not allow for what is known as "part load testing" (vs. maximum load).Therefore, they do not account for energy use or loss during, for example, minimum compressor speed. They also so not provide for seasonal (temperature) descriptors with the consequence of not providing sufficient detail to accurately state building energy requirements.

Based on data and information from the U.S. experience moving from EER to SEER and from recent information from the Middle East, South America and Asia, both manufacturers and governments see value in the SEER system. Several countries have asked ARI for help in establishing certification programs similar to ARI's with the objective of establishing a more rational and even playing field in assessing equipment efficiency and to enjoy the gains from using SEER Governments gain because they have a better assessment of energy needs, and manufacturers are rewarded in the market place for producing better equipment. The consumer gains by being able to make rational economic choices.

TC 86's work program is substantial. How do we get the job done? There are currently 33 standards published by the TC. The list of published standards in TC 86 can be found on the ISO Website, www.ISO.ch, and the work for Subcommittees 3 and 6 can be found at: www.ari.org/international activities/international standards. Throughout its subcommittees 12 new standards are under development covering the following subjects:

- Terms and Definitions;
- Automatic Ice-Makers and Storage Bins – Testing and Rating for Performance;
- Mechanically-Refrigerated Drinking Water Coolers;
- Transportation Refrigeration Equipment, Sound Measurements and Acoustical Rating of Performance;
- Household Refrigerating Appliances—Characteristics and Test Methods;
- Testing and Rating of Air Terminals;
- Testing and Rating of Air Diffusers;
- Sound Rating of Air-Conditioning and Air Source Heat Pump Equipment—Part 3, Ducted Equipment; Air-Conditioning Condensing Units; Multi-Splits;
- Room Fan-Cool Units—Testing and Rating for Thermal Performance;
- Water Chilling Packages Using the Vapor Compression Cycle—Testing and Rating for Performance;
- Cooling Towers—Testing and Rating for Performance;
- Recovered Refrigerants;
- Refrigerant Lubricants.

Several standards are under revision; these include:

- Mechanical Refrigerating Systems Used for Heating and Cooling—Safety Requirement;
- Non-Ducted Air Conditioners and Heat Pumps—Testing and Rating for Performance;
- Ducted Air Conditioners and Heat Pumps—Testing and Rating for Performance;
- Refrigerants—Number Designation.

The breadth of TC 86's work program is impressive and the work should continue.. Yet, measured against the number of standards in the mature standards portfolios of HVAC&R standards published by ARI and ASHRAE (over 235), it is clear that TC 86 has a substantial amount of work yet to be done to provide a complete inventory of international HVAC&R standards.

The rapid development of HVAC&R standards is necessary for ISO to be a creditable source of such standards to fulfill our goals of eliminating technical barriers to trade and transferring needed to technology globally. This will require two efforts. First, those member-bodies already participating in TC 86 must consider increasing the resources needed to complete existing work, while concurrently starting new work. Resource limitation force the unnecessary delay of program start-up and rob TC 86 of its ability to stay current. Second, those member bodies who are currently "Observer" members must reassess their roles and if consistent with national industrial interests become participating members.

**Conclusions:**

**1.** International standardization in the HVAC&R industries should be carried out in a fashion that ensures resulting standards successfully address issues of energy efficiency, environmental stewardship and a level playing field for manufacturers.

**2.** Successful international standards will be those that address the key issues defined in Conclusion #1 in a timely way.

**3.** International standardization is a key activity for the Air-Conditioning and Refrigeration Institute (ARI). ARI is committed to working with international standardizing bodies such as ISO and IEC.

**4.** ARI will continue its role as a North American based standards developer of HVAC&R testing and Rating programs with global interests.

**5.** ARI's standards and certification programs are global in nature will continue to meet global market demand.

6. Seasonal Energy Efficiency Ratio (SEER) is a superior measure to Energy Efficiency Ratio (EER) because it better approximates real world conditions. As such, it allows manufacturers to better compete and to meet market conditions, governments to develop a more informed energy use and conservation policy and consumers to make more informed choices**.**7ISO TC 86's work program is already a large one. Completing and expanding it to have a more comprehensive HVAC&R portfolio of standards requires two things; increased participation by existing members and new involvement by those members who currently hold "Observer" status.

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