SENSIBLE HEAT RATIOS: *What Happened?*

by Glenn C. Hourahan, P.E. and Karim Amrane, Ph.D.

Changes in the physical space in buildings, as well as operations, processes, and HVAC equipment operation schemes profoundly influence the latent requirements needed from HVAC equipment.

So here's the question — with so much anecdotal field information today indicating that relative humidity control is a growing concern, how can the latent capability of today's equipment be the same as equipment from 10, 20, and 30 years ago?

To find out, a study was completed in 2002 to assess whether latent capacity of residential and commercial unitary equipment has a relationship to efficiency.

An ancillary objective was to determine if the moisture removal capability of unitary products had declined over the years as equipment efficiencies increased. The table below summarizes a portion of the data examined from the Air Conditioning and Refrigeration Institute's (ARI's) unitary certification test programs.

In the assessment, no particular correlation was found between equipment sensible heat ratio (SHR) and equipment efficiency. In other words, units with low energy efficiency ratios (EERs) had measured latent performances in the same range as units with high efficiencies.

Additionally, the data indicated that on average, the SHR is on the order of 0.72 (i.e., 72% of an equipment's cooling capability addressed the sensible load and 28% addressed the latent load). As seen in the table, unitary equipment SHRs have remained relatively constant over the past 30 years.

If relative humidity problems in buildings are such an issue, how is it possible that the latent removal capability hasn't changed?

A small part of the answer is steady-state vs. transient operation. The ARI data sets used for the above study were for full-load, steady-state operation. Although steady-state equipment SHR capability remains unchanged over the decades, evolving manufacturing practices have resulted in today's equipment operating somewhat differently in the transient, non-steady state mode (i.e., start-up after each off-cycle).

Over the years, improved equipment efficiencies came about due to better compressors, motors, heat exchanger surface areas, and enhanced controls. However, newer heat exchanger surfaces are packed tighter with tubes and fins. This provides more surfaces for the condensate to readily adhere to, and not so readily drop into the drain pan.

Additionally, evolving control sophistication (i.e., staging, fan time delays, metering devices, etc.), and refrigerant management techniques (as well

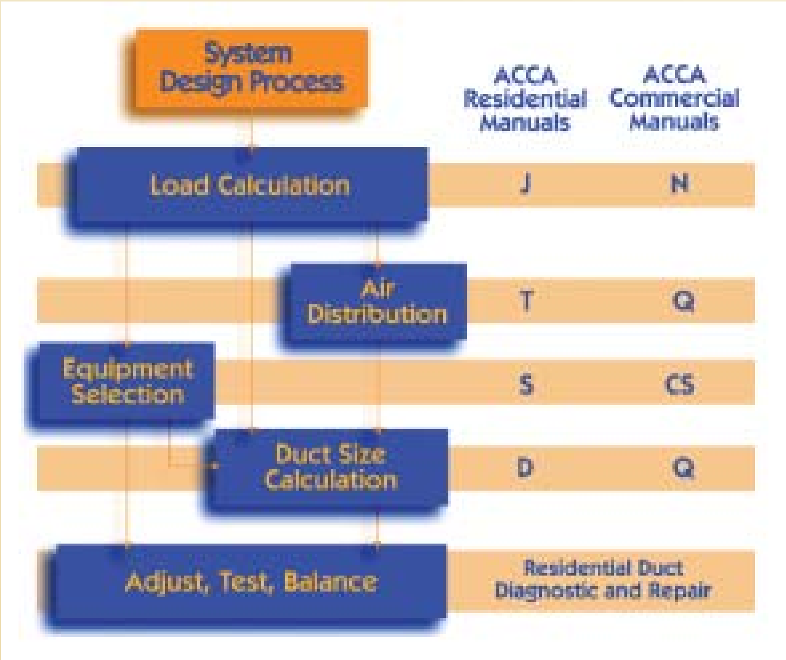
Is Latent Removal as Good as it Used to Be?

ARI Test Data: Residential Equipment

	1971	1976	1986	1994	2001
EER-A					
Range	5.0 — 8.5	6.0 — 9.8	—	8.0 — 12.1	8.3 — 14.3
Average	6.4	7.3	—	9.9	10.2
SEER					
Range	—	—	7.8 — 2.1	9.2 — 14.7	9.5 — 16.4
Average	—	—	9.6	11.0	11.6
SHR-A					
Average	0.72	0.73	0.72	0.72	0.70
SHR-B					
Average	—	—	0.69	0.69	0.68

Moisture Control Requires Good Overall System Design

Sizing the load correctly is only an initial step in providing proper indoor conditions. To ensure that air conditioning systems are correctly applied for occupant comfort, health, and safety, a number of industry-recognized practices should be observed. Each element in the design process is interrelated, and successful execution of one is dependent on proper completion of earlier elements. A systems approach results in better application control and customer satisfaction.



as refrigerant levels), may increase the amount of time needed for modern HVAC equipment to reach steady state operation. Hence, the increased time for the evaporator to reach its coldest operating temperature reduces its latent ability during this transient period.

Equipment oversizing exacerbates this issue as equipment short-cycling prevents the evaporator from reaching its maximum potential for long periods of transient operation.

A larger part of the answer is application sensible heat ratio vs. equipment sensible heat ratio. While steady-state equipment SHRs may not have changed over the years, the typical building application SHR has dramatically changed.

Application SHR is largely a function of equipment type, operation mode, and the latent loads generated within the building, infiltrated through the envelope, or introduced as ventilation requirements.

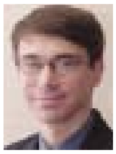
Adaptations in the way buildings are constructed, maintained, and the on-going processes/activities within them, have resulted in lower application SHR requirements than typically seen one and two decades ago.

Particularly related to changing application SHR is the on-going evolution occurring with building codes and standards. Two industry standards significantly affecting application SHRs are ASHRAE Standard 90 (i.e., save energy by making buildings tighter) and ASHRAE Standard 62 (i.e., improve indoor IAQ by bringing in outside ventilation air).

These two standards in combination — tighter, non-breathable envelopes with introduction of potentially moist outdoor ventilation air — make for some challenging design considerations in humid areas.

As an example, nearly all constant-volume HVAC equipment in commercial buildings functions with continuous fan operation during occupied hours; the compressor(s) cycle on-and-off based on thermostat set points (sensible control). This implies that when the cooling set-point is satisfied, a relatively large quantity of unconditioned — generally, warm and moist — outside air is continuously introduced into buildings. This has a powerful effect on the equipment dehumidification load and, if relative humidity levels become too large, on building integrity and occupant comfort.

Changes in building practices, occupancy density/office arrangements, business operations/processes, and HVAC equipment operation schemes have profound influences on the latent requirements needed from HVAC equipment. All of this highlights the critical importance of ensuring that HVAC systems are rigorously sized, suitable selected, correctly installed, properly operated, and appropriately maintained. ■



Glenn C. Hourahan, P.E. *is the vice president of Research and Technology for the Air Conditioning Contractors of America (ACCA) in Arlington, VA. Hourahan can be reached at 703/824-8865 or you can e-mail him at* **glen.hourahan@acca.org**.

Karim Amrane, Ph.D., *is director of public policy at the Air-Conditioning and Refrigeration Institute (ARI) in Arlington, VA. Amrane can be reached at 703/524-8800 or by email at* **kamrane@ari.org**.