

# How to Measure Commercial System Efficiency

By Rob “Doc” Falke, National Comfort Institute

It's just not fair. Some contractors have a distinct advantage in the marketplace over their competitors; they ruthlessly and knowingly measure the live operating efficiency of HVAC systems. With the knowledge they gain, they diagnose and prescribe solutions to system defects that others don't even know exist. Their prices are much higher and the efficiency of their systems far exceeds their competition. Let's take a look at why the gap between everyday HVAC contractors and Performance-Based contractors is widening.



## ■ What is Commercial System Efficiency?

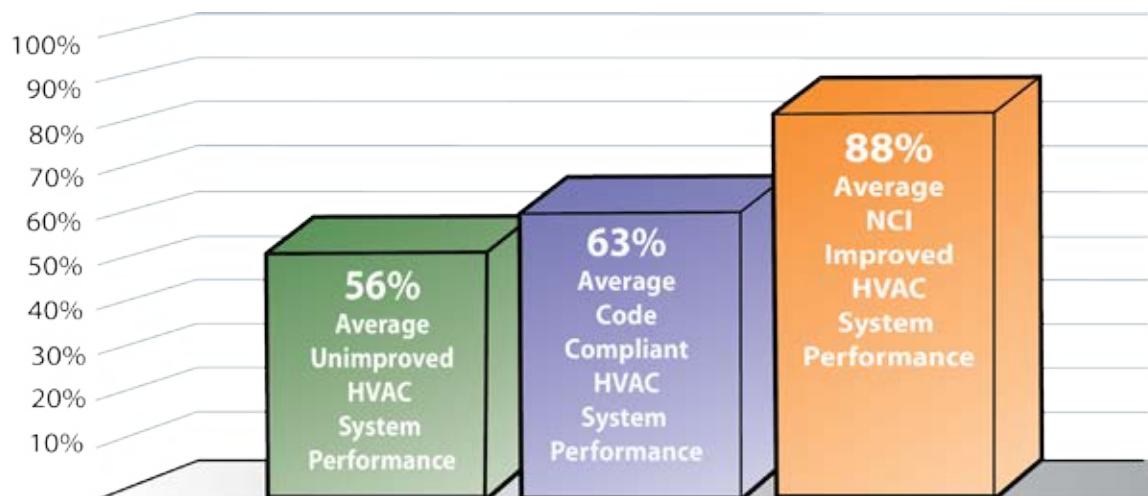
You're familiar with EER (Energy Efficiency Ratio) and AFUE (Annual Fuel Utilization Efficiency) ratings for residential (remove the word residential) cooling and heating equipment. But commercial system performance or efficiency is a different animal. It's the rated operating efficiency of a system as it performs under live operating conditions in the field as measured by a certified technician.

Rated equipment efficiency is a laboratory measured number established under perfect conditions. This

number expresses the absolute *potential* efficiency of the equipment.

The truth is that a far more important number is the measured efficiency of the system (equipment and distribution system efficiency) once it's built and installed.

A decades-old mistake contractors make is to sell systems by promising the efficiency of the box, and failing to address how well that box performs as part of a system, once it's operating in the field. Shouldn't there be a law against that?



The operating efficiency of a system, or Cooling System Efficiency Rating (CSER), is a field measured ratio of the actual Btu delivered into a building after installation, divided by the rated Btu of the equipment in the laboratory.

For example -- a 10-ton cooling system's performance is measured at 72,000 Btuh and the

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equipment is rated at 120,000 Btuh. You can find the CSER of the system by dividing 72,000 into 120,000 to learn the system is only operating at 60%.

Shocking? Oh yeah! Rare? Hardly. Actually, the typical commercial HVAC system is only operating at a field measured efficiency of 56%. If you think code compliance helps, the typical code compliant system only operates at 63% CSER. So the question is: at what percent of efficiency is the last system you sold, installed, or serviced performing?

In reality, few are even aware of the problem and fewer take the time to measure the operating efficiency of their systems.

Your customers are the ones who really want to know, because they pay the long-term cost of poorly performing systems. The typical CSER of a commercial HVAC system that has been renovated and commissioned by a certified technician is 88%. The result is a system that performs more than 50% better than the typical commercial system.

Once your customers understand the difference between the equipment efficiency ratings and system operating efficiency; the conversation shifts from box efficiency to system efficiency. Contractors and technicians who have developed the skills necessary to measure system efficiency move far ahead of the market into a zone where they operate with little, if any competition.

## ■ How is CSER measured?

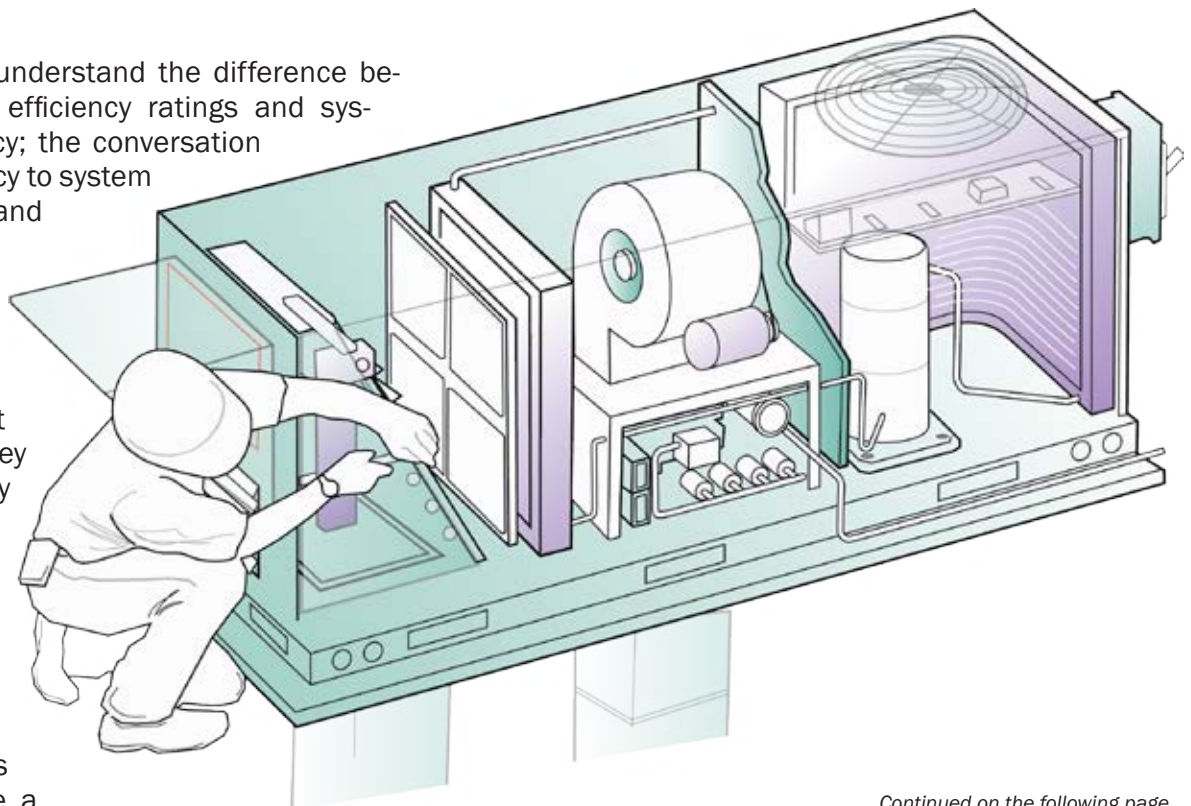
Although there are many supporting standards and procedures to consider, let's take a

look at the basic steps required to measure CSER.

**Step one** - Determine the rated Btuh of the equipment under current operating conditions. Say you have a 10-ton cooling system on a 90° F day operating at 350 cfm per ton with an entering wet bulb of 63° F. The rated cooling capacity under these conditions is 115,000 Btuh. This is the rated capacity of the equipment.

**Step two** - Measure the delivered supply airflow into the building. This is usually done with a calibrated commercial balancing hood. Simply measure each supply register and add together to find the total supply airflow into the building. Let's say this 10-ton system is delivering the typical airflow of 2800 cfm (even though the required airflow is 4000 cfm).

**Step three** - Determine the average enthalpy of the air temperature at the supply registers and the return grilles (*If your hygrometer doesn't measure enthalpy directly, you can measure wet bulb and convert to enthalpy, email Doc for the needed procedures*).



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Timing and precise procedures are required to do this correctly. Say the average return grille measures 27.81 BTU per pound of air and your average supply register enthalpy measures 22.49. Subtract to find an enthalpy change of 5.32.

**Step four** – Calculate the Btu delivery of the system into the building by multiplying the delivered supply cfm of 2800 by the system enthalpy change of 5.32 times the multiplier of 4.5. The system delivered Btuh is 67,032.

**Step five** – Calculate the system’s operating efficiency or CSER by dividing system delivered Btuh of 67,032 by the equipment rated Btuh of 115,000 to find only 58% measured system efficiency.

As you can imagine, if you found 58% CSER on a system you recently installed or serviced in the field, many questions would be raised.

If an outside air inlet or an economizer is included with the system, there are additional steps required.

Fortunately, the same series of tests that enable you to calculate CSER also provides the best data to allow you to diagnose the system, find the defects that affect system performance, and offer solutions to your customers. Most likely, these solutions will be highly desired by your customers, but invisible to your competitors.

## ■ Defining Quality

The most overused word in the HVAC industry today is quality. Quality is of no value unless it can be measured and expressed in numbers. In 1883 Lord Kelvin said, “*When you can measure what you are speaking about and express it in numbers, you know something about it. But when you cannot measure it or when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind.*”

Without a quantification of quality, all we have are more non-quality jobs. Try selling one of those to your customers. CSER is the missing measurement of quality in HVAC systems. Its brother – HSER or Heating System Efficiency Ratio – is the measurement of quality for heating systems.

## ■ You and Your Customer

The industry has done a fair job of making our customers want efficiency. As you may see from this article, the season has come for progressive contractors and technicians to evolve to the next level of efficiency. The moment your customers learn about system efficiency, the importance of equipment efficiency will fade.

The only question is; will you be your customer’s source for this new level of system efficiency? Or, will it be someone else escorting your customer beyond laboratory efficiency ratings?

**Rob “Doc” Falke** serves the industry as president of National Comfort Institute an HVAC based training company and membership organization. If you’re an HVAC contractor or technician interested in a free CSER or HSER Test and Calculation



Procedure, contact Doc at [rob@ncihvac.com](mailto:rob@ncihvac.com) or call him at 800-633-7058. Go to NCI’s website at [nationalcomfortinstitute.com](http://nationalcomfortinstitute.com) for free information, articles, and downloads.