Get the FACTS about SEER and Deliver Better Customer Value

What is SEER?

SEER stands for **S**easonal **E**nergy **E**fficiency **R**atio. It's a number that describes how well air-conditioning equipment works. A higher SEER means better efficiency and lower energy bills. SEER is calculated by dividing the amount of cooling supplied by the air conditioner or heat pump (Btu's per hour) by the power (watts) used by the cooling equipment under a specific set of *seasonal* conditions.

SEER ratings are determined in a laboratory where the exact set of indoor and outdoor conditions–specified by the US Department of Energy–are guaranteed to exist. Because each piece of cooling equipment is evaluated using the exact same conditions, the SEER rating can be used in comparing the performance of equipment from different manufacturers.

Higher SEER ratings can be achieved by manufacturers who use newer or better technology in their equipment. That's why SEER ratings have a big influence on equipment costs. That's also why SEER has become an important part of manufacturer and HVAC marketing programs.

Many people know that SEER ratings are important in selecting equipment. What most people don't realize is that the HVAC contractor has a major role in making equipment perform up to its real capabilities in the home environment. Knowing the SEER FACTS can help!

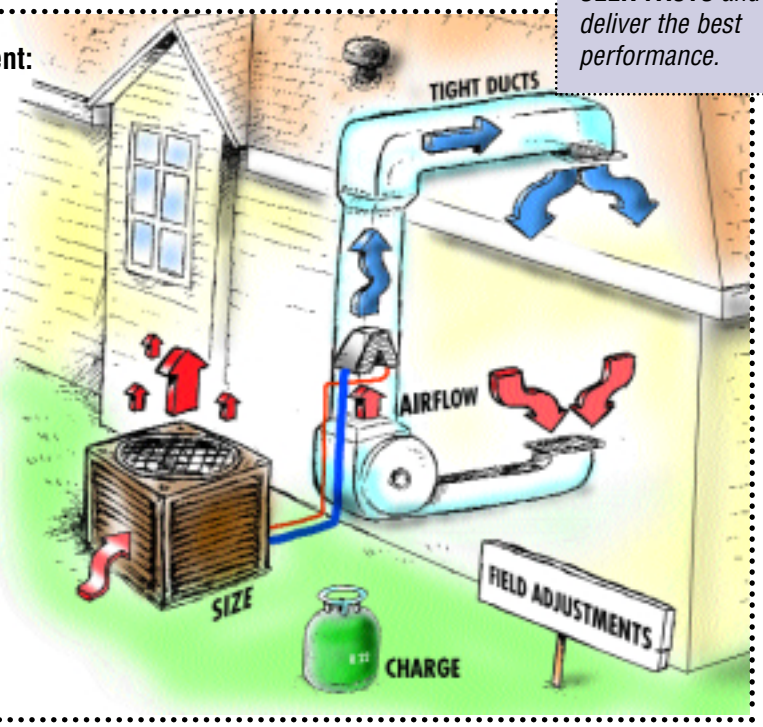
When a manufacturer sends equipment to a laboratory to establish its SEER rating, you can bet the equipment is set to perform its best under the test conditions. But *real* conditions in a home, not controlled lab conditions, determine how equipment will perform for your customers. That's why understanding how SEER is affected by *actual field conditions* will help you deliver the most benefit from higher SEER equipment.

Many things affect how cooling equipment meets its anticipated performance level. Weather is one example. The same equipment installed in a northern climate will naturally use less energy to keep a home cool than a similar system installed in a southern climate. HVAC contractors cannot control Mother Nature. But there are key parts of the cooling system that affect SEER that HVAC contractors can control.

You owe it to your customers to be in control of the FACTS about SEER. The field adjustments that you'll need to master involve four key system factors, as illustrated in the diagram below. A contractor who masters the FACTS about SEER may even be able to deliver greater comfort and lower energy costs using SEER 10 equipment than another contractor delivers using SEER 14 equipment!

*Look inside for surprising information about the impact the field adjustment factors can have on equipment performance (SEER rating). You'll also find tips that will help you master the **SEER FACTS** and deliver the best performance.*

Field Adjustment:
Airflow
Charge
Tight ducts
Size



Why Doesn't Equipment Perform Up To Its SEER Rating?

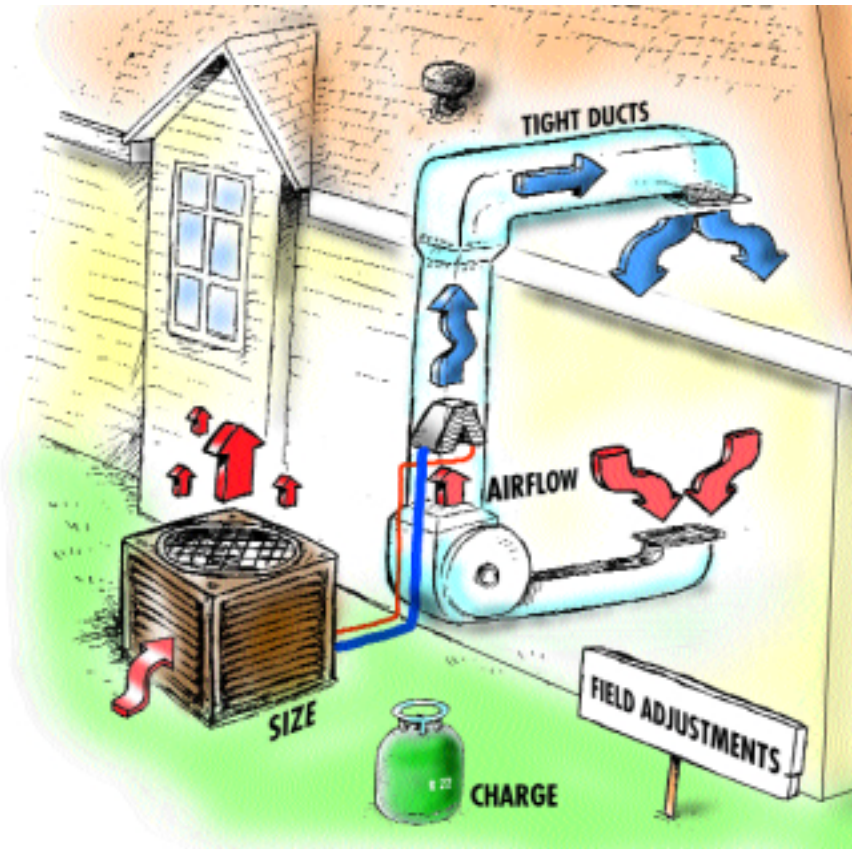
SEER rating refers only to the performance of the condenser and evaporator equipment. However, HVAC contractors use many independent pieces to construct the complete air-conditioning system. Every system is uniquely constructed for each customer's home. Manufacturers of the condensers and evaporators usually specify the system conditions that should be met in order for their equipment to achieve the best performance results. But field experience often shows that these conditions are not being realized, and the equipment performs lower than its rated SEER.

The HVAC contractor's first challenge is to choose the right pieces and then to tune the whole system so that it delivers the best performance. For example, using a duct system that doesn't meet industry standards or the specifications of the equipment manufacturer can cause an air conditioner to deliver far less than its laboratory SEER rating. SEER 12 equipment may perform no better than SEER 6 equipment when installed in the actual home environment. Needless to say, homeowners are not pleased with their purchase when the system performs at half of its rated efficiency!

By studying and understanding SEER FACTS (the four factors that affect the field-adjusted performance), you can deliver greater comfort and better value to your customers. These diagrams illustrate the relationship of these four factors in an air-conditioning system.

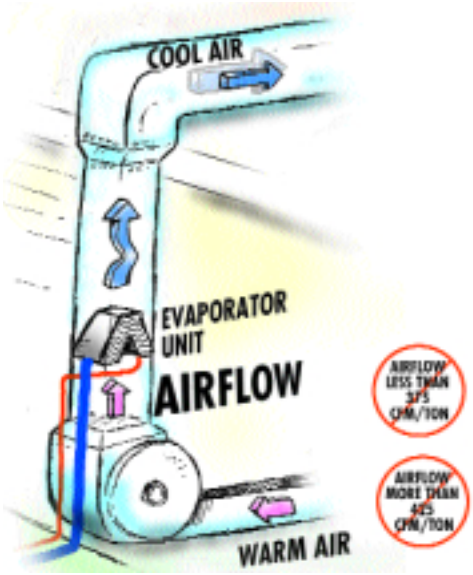
Field adjustments: A closer look at the FACTS

On the pages that follow, each of the four field adjustment factors will be discussed in more detail. Graphs are provided to help you understand how the lack of control of each factor can affect SEER performance.



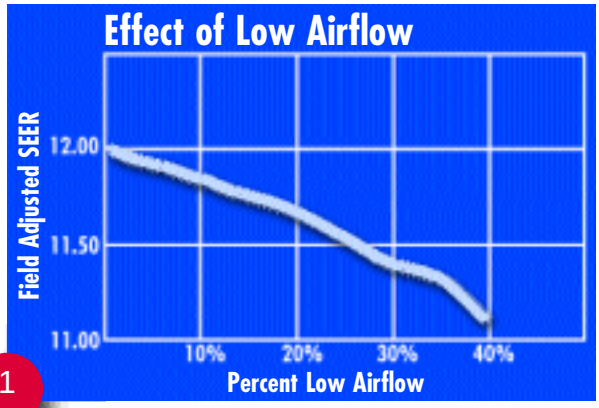
Airflow

Without proper airflow, the desired temperature change across the evaporator will not occur. Graph 1 shows the reduction in the field adjusted SEER caused by various levels of inadequate airflow.



Low air flow is often caused by:

1. Ducts that are too small.
2. Duct layout that restricts airflow.
3. Poorly selected or restricted grilles.
4. Mismatch of air handler with the other equipment.



1 *Effects of Incorrect Airflow on Rated SEER*

Refrigerant flow control devices affect field adjusted SEER

Air conditioners use two types of refrigerant flow control devices, which operate like gates to control the refrigerant flowing throughout the system. *Thermal expansion valves* are "self-correcting" because the gate opens and closes depending on how much refrigerant the air conditioner needs. With *fixed orifice flow control*, the gate stays open at the same level regardless of conditions. Each of these types of systems is affected differently by field adjusted performance factors (SEER FACTS).

Fixed orifice flow control

Systems that use a capillary tube, accurator, piston, or a short tube orifice all have fixed orifice flow control. More than 75% of the equipment with lower SEER ratings use this technology because it is the simplest flow control method and it costs less. About 70% of the systems sold nationally use fixed orifice technology. Fixed orifice air conditioning systems are particularly sensitive to field adjusted performance factors such as airflow and refrigerant charge.

Thermal expansion valves (TXV or TEV)

Systems with thermal expansion valves have more sophisticated flow control technology. The thermal expansion valve will adjust the refrigerant flow depending on the evaporator coil temperature. This results in a system that is more forgiving of improper airflow and refrigerant charge. TXV systems are usually found in higher priced and higher SEER rated equipment.

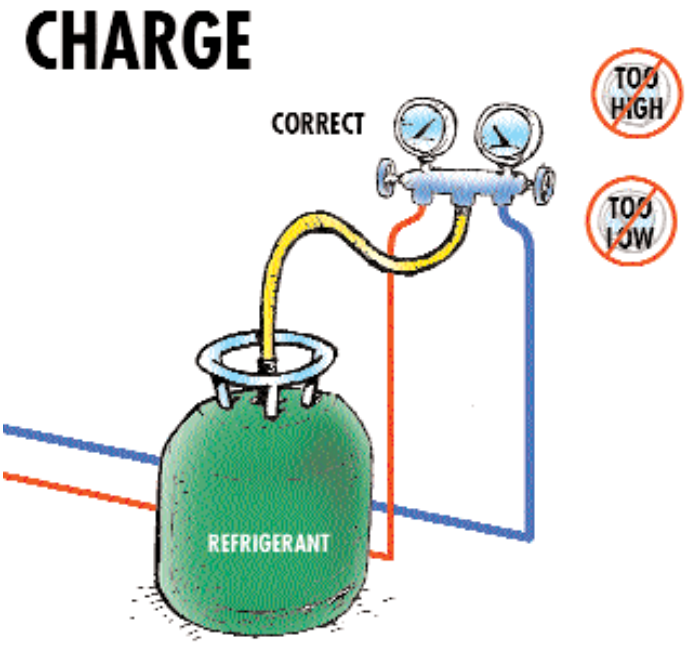
Field studies show that:

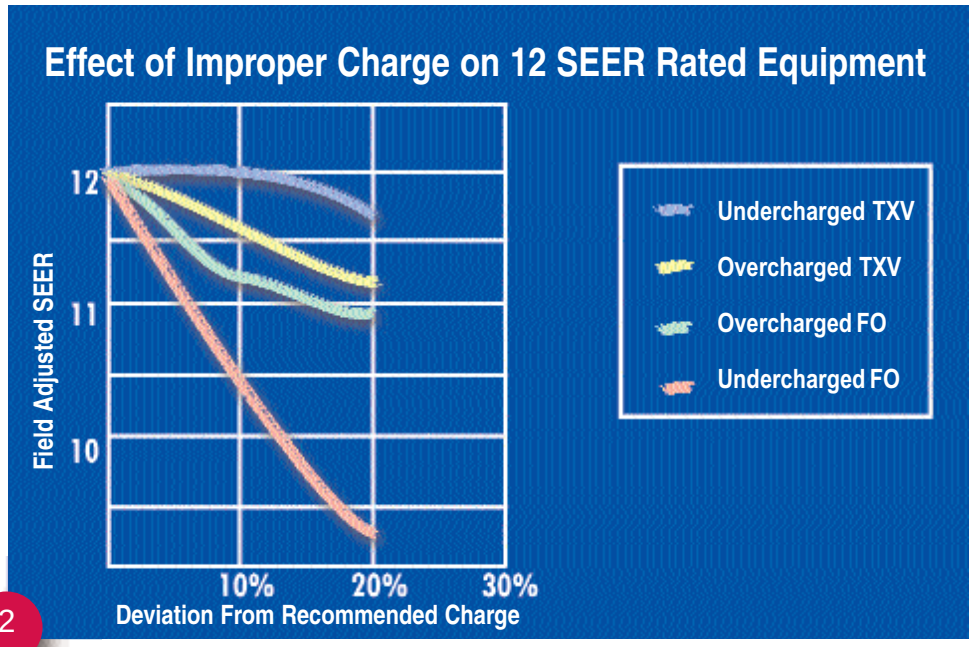
- Airflow through the evaporator is typically lower, not higher, than the manufacturer's recommendation of 400 cfm per ton.
- Improving system airflow to recommended values could reduce residential cooling energy use by an average of 10%.
- A system using *fixed orifice flow control* is more seriously affected by low airflow than a system using a *thermal expansion valve (TXV).*

Getting the right refrigerant charge is a critical field adjustment factor that is often overlooked. The effect of improper charge depends on the type of refrigerant flow-control device being used in the system. A system using fixed orifice flow control is more seriously affected by improper charge than a system using a thermal expansion valve (TXV). Graph 2 shows the estimated effect of having these two types of systems undercharged or overcharged by up to 20%. Notice that big changes in the performance can occur within this relatively small range of improper charge.

How common are improperly charged systems? Studies show that under real field conditions:

- About 7 out of 10 systems have an improper charge.
- While most systems are undercharged, some systems are overcharged by more than 100%.
- Systems with longer line sets tend to be much more severely undercharged than systems with shorter line sets.
- Mismeasurement of line set length is a common cause of improper charge in precharged systems.





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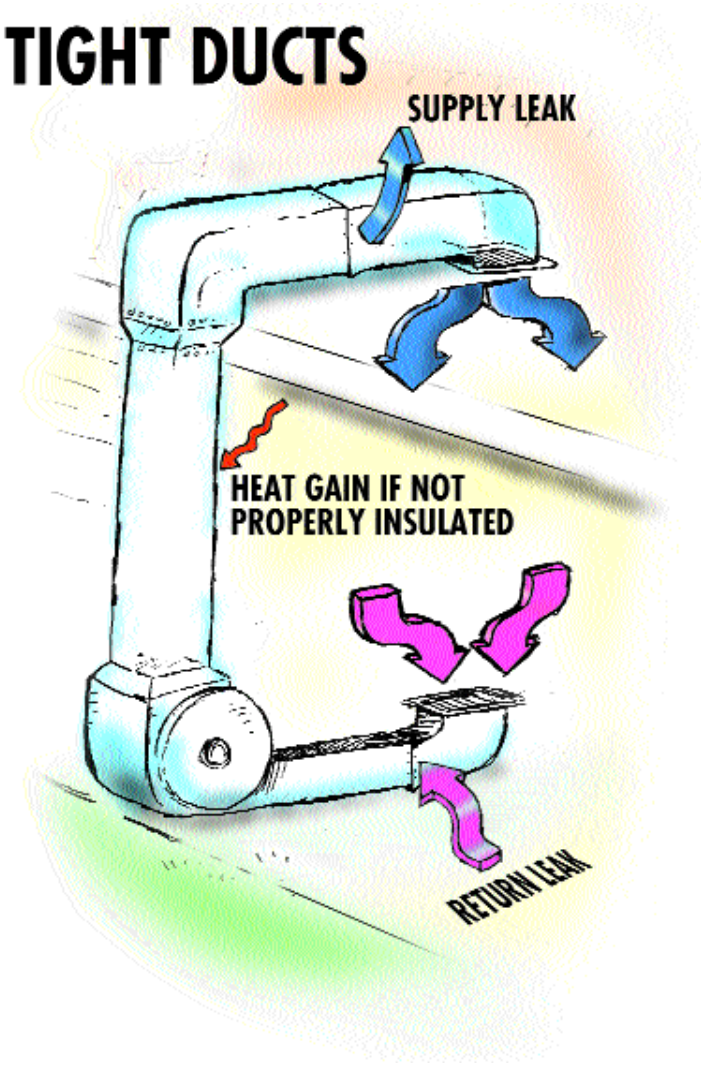
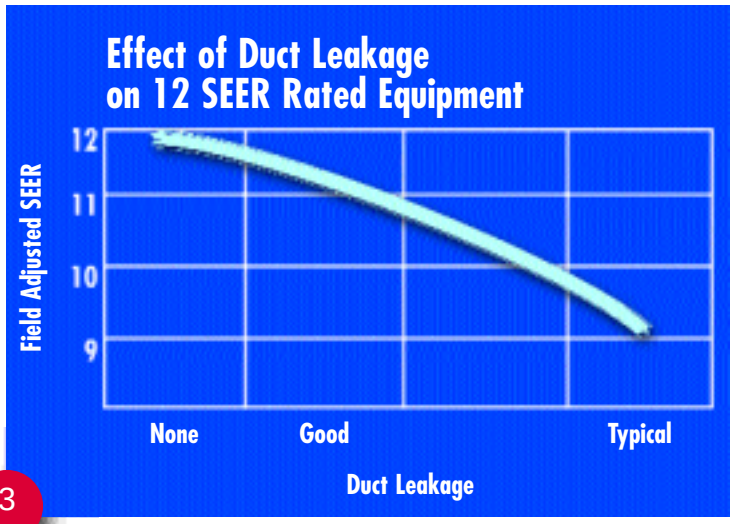
Impacts of Incorrect Charge on Rated SEER

Making sure that the system has tight ducts is another important measure that will help the air-conditioning equipment perform up to its SEER rating. Duct leaks have three basic effects on the system's cooling load and the amount of energy the system requires:

- Leaks in the supply ducts cause a direct loss in the system's total capacity.
- Leaks in the return ducts often bring unconditioned and unfiltered air into the house from the attic or crawlspace.
- The *difference* in supply leakage and return leakage causes an additional negative effect on energy use from the infiltration it causes.

Field studies based on air distribution ducts in existing homes show that about 35% of a system's cooling *capacity* is lost from duct leakage and from thermal losses due to poorly insulated ducts. Proper sealing and insulation of ducts is estimated to cut those losses in half. Graph 3 shows how the reduction in *efficiency* caused by duct leakage can affect performance of the air conditioning equipment.





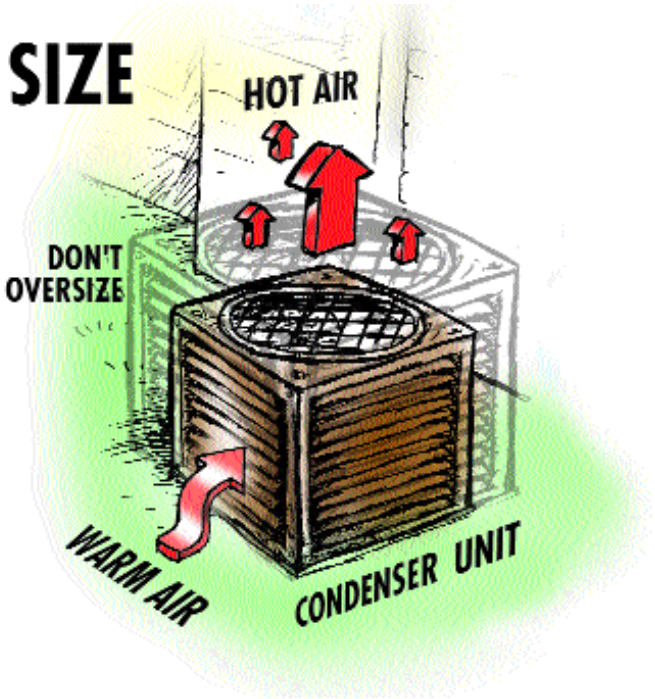
3 *Impacts of Duct Leakage on Rated SEER*

The proper size for equipment is really a matter of definition. Equipment that is “too big” will keep people comfortable when there is a large cooling demand, but it will hurt performance and be a burden the rest of the time. Often times, equipment that is “too small” will not satisfy the cooling needs. According to American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) recommendations, a system should be designed so that it runs full time for 2.5% of the summer season.

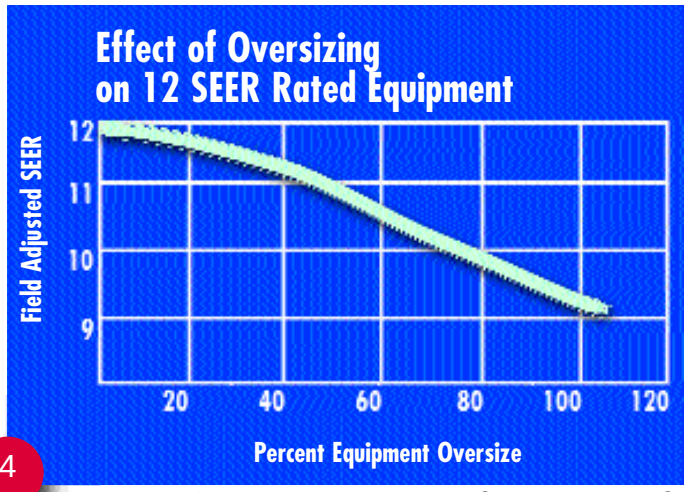
Builders and contractors often oversize because they think it will reduce service calls. Field studies show that central air conditioners are, on average, being oversized from 24% to over 100%. Graph 4 shows how reduction in efficiency caused by oversizing can reduce the performance of air-conditioning equipment.

Oversizing has a bad effect on energy use, comfort, equipment life, and system costs:

- Oversized equipment often runs for very short periods and often may not reach its steady-state “cruising speed” where it operates most efficiently. Oversizing by 50% has been shown to increase seasonal energy use by 9%.
- Very short runtimes mean indoor air doesn’t get mixed, and uncomfortable “hot spots” occur in kitchens and sunny rooms.
- Very short runtimes can leave too much uncomfortable humidity in the air.



- Comfort problems lead homeowners to lower the thermostat, leading to unnecessary energy use and increasing the risk of condensation problems.
- Homeowners spend more time on the outside fringes of the comfort zone and often reset the thermostat.
- Wear and tear on equipment results from too-frequent stopping and starting.
- Costs of equipment, installation, and maintenance are all higher.



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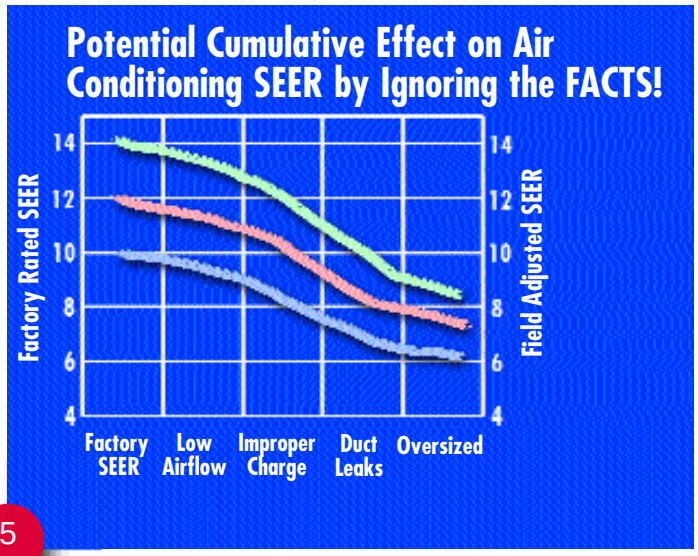
Impacts of Incorrect Equipment Size on Rated SEER

Airflow, charge, tight ducts, and sizing–each one plays a key role in how air-conditioning equipment actually performs in the field. Ignoring any one of those factors can result in a significant loss in equipment performance. But the *combined* effect of problems from multiple factors can add up to a huge decrease in performance. This chart shows the potential cumulative effects of ignoring all the SEER FACTS. It is not uncommon to find air-conditioning systems in the field that deliver only half of the potential benefit from its high SEER rating.

The HVAC contractor plays the major role in ensuring that homeowners get the benefits of the SEER level that manufacturers build into the equipment. By understanding SEER FACTS, contractors and technicians can provide better value to their customers. Training and quality programs can help you and your company develop ways to understand SEER FACTS and give customers the rated SEER that they paid for.



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Each of the Field Adjustment factors are assumed to act on SEER independent of each other; the actual combined effect may, in fact, be different than what is represented in this chart.

Values on this chart reflect fixed orifice air conditioning systems.

Manage SEER FACTS to Create Satisfied Customers!

Focus on the SEER FACTS to provide the highest performance…

Field Adjustment performance factors:

Airflow for the system near 400 cfm per ton

Charge refrigerant properly

Tight ducts — avoid leak to outside

Size equipment correctly

*Delight your customers year round! **

Enhance comfort

Reduce hot spots and excess humidity when systems run at proper frequency and duration.

Reduce initial equipment costs

Use lower SEER equipment to produce the same or better results.

Make equipment last longer

A system can last 15 years instead of 10 years.

Reduce monthly energy bills

A homeowner with a $200 monthly bill could see it drop to $120.

* *While SEER is a measure of cooling effectiveness, SEER FACTS also have a major impact on the energy and system performance of heat pumps during the heating season.*

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