Tech Tips II *Temperature Systems Inc.*

Madison -- Green Bay -- May 05

Replacing a Condensing Unit

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The Department of Energy's 13 seasonal energy efficiency rating (SEER) standard for residential central air conditioners will take effect January 23, 2006. As this date approaches, it's likely that the 13 SEER standards will be part of your discussion with homeowners who are considering the replacement of their current HVAC systems.

The 13 SEER and greater units certified by the Air-Conditioning and Refrigeration Institute (ARI) will increase efficiency by as much as 30 percent over the 10 SEER models that meet the current SEER standard, lowering operating costs for the consumer. However, the efficiency of any unit is only be as good as the steps taken by the HVAC technician before the actual replacement of the old system.

The contractor should begin by asking why a unit is being replaced.

The answer to this question may impact the design of the new system. For example:

- If the compressor is defective, it is important to know whether the problem is the result of a mechanical or an electrical failure.
- A mechanical failure suggests a number of possible causes, not the least of which is the original application may not have been correct.
- Other possible influences would be poor maintenance, which may have created an airflow problem leading to flood-back.
- Electrical failures may have been tied to voltage issues or even a lightning strike.

Understanding the reason for failure and then taking the steps to correct it can prevent premature failure of the replacement unit.

You should also ask the owner questions about the unit's performance prior to the failure.

- Did the system cool properly in the summer and did you feel comfortable with regard to the humidity level in the house?
- If it's a heat pump, or attached to furnace, did it heat properly in the winter?

If the comfort level with the old system was not to their satisfaction, you will need to determine the cooling and heating loads for the home by performing a load calculation.

-Consider using the Air Conditioning Contractors of America's Manual J. A soon to be released Version 8 Abridged Edition, along with well-designed and easily available software, has simplified this once complex task.

The load calculation looks at all those things about the home and the customer that impacts the amount of cooling required to maintain a comfortable environment. Even when accurate input data is used, a Manual J load calculation will more than likely be 10 to 15 percent higher, as a result of assumptions built into the program.

Chances are, if the homeowner complained about being too warm with their old unit when outside temperatures reached 95 degrees, the load requirement for the house may have changed, and a larger unit is probably required. On the other hand, if the customer has been sweaty or clammy in the past, the old unit may be too large, with respect to the load calculation, causing short run cycles. This leads to improper latent cooling, resulting in a cool, yet uncomfortable environment for the homeowner. Both cases demonstrate the need to perform a new load calculation prior to selecting and installing the replacement condensing unit. Improper sizing of the new unit will impact both unit efficiency and consumer satisfaction.

Questions

Call TSI Tech Service department at:

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The existing evaporator coil can also impact the efficiency of the new condensing unit, especially if it is not matched to the new unit. Almost without exception, coils that are not part of a matched system that has been ARI rated will not deliver the rated performance of the condenser. This means that a 13 SEER unit matched with an older, less efficient evaporator coil will not achieve the efficiency a 13 SEER unit is designed to deliver. This holds true even if you could replace the metering device in the existing coil with one you “think” would be sized correctly. As a result, replacing the old evaporator coil with a new coil matched to the new condensing unit is usually the most prudent step to take.

The refrigerant in the new condensing unit will also influence the fate of the existing evaporator coil. If the existing unit uses R-22 refrigerant, instead of the R-410A refrigerant typically found in 13 SEER units, the evaporator coil may not meet the elevated pressures of R-410A. Some older coils were tested for 250- to 350- pounds-per-square-inch gauge (psig), while new coils are tested for 500 psig, making them suitable for R-410A applications. As a result, most HVAC manufacturers advise against matching a new 13 SEER unit that uses R-410A refrigerant with an old evaporator coil that was part of an R-22 system.

Replacing the old evaporator coil with a new coil also eliminates concerns associated with signs of corrosion or contaminates left behind as a result of the original unit failure. Additionally, replacing the coil removes the question of existing leaks, which may not have been detected during the operation of the old system. In addition to the evaporator coil and the lineset, the contractor should inspect the air handler or furnace, looking at its physical condition as well as its size in relation to the new condenser. This inspection should also include an examination of the electrical service and connections on the unit, blower, motor bearings and blower wheel.

It's important for the estimator to look closely at the existing indoor coil as regards size and location. Newer coils designed for use in 13 SEER applications typically have more coil surface area and as such may be physically larger meaning, ductwork transitions will need to be made. The new coil may also have a higher pressure drop which can have an enormous effect on airflow. The existing blower may be operational, and may be part of a furnace that will not be replaced. But if the blower motor does not have the capacity to deliver the needed airflow due to the additional load, it may have to be replaced. At this time we need to look at the blower wheel and determine the maximum CFM it is capable of delivering vs. the HP given.

Another part of the HVAC system in need of inspection is the ductwork. Just as other system components need to be properly sized, so does the ductwork. If the load calculation mandated a change in unit capacity, the required CFM will have changed. Airflow required for the older system may not be adequate for a newer, more efficient 13 SEER unit. Look to ACCA's Manual D for more information on duct sizing.

Air filters are an integral part of the duct system. Improperly sized or poorly maintained filters are another source of problems, as are grilles and registers that are not open or clean and free of furniture, carpet or window treatments.

An inadequate electrical system presents the potential for additional problems. Therefore, it makes good sense to examine the electrical service to the home, checking the amperage to make certain it meets the needs of the new condenser and verifying the existence of a properly sized grounding rod and wire to the electrical fuse or breaker box. In some cases, it may be necessary to enlist the advice of a licensed electrician. By taking this step, the contractor is in a position to make recommendations regarding the size of the power lines from the fuse or power box to the condenser unit, as well as the size of the indoor control transformer and the circuit for the indoor air handler.

Although it may not be required, it is always strongly recommended that the lineset be replaced when a condenser is being replaced. Proper sizing is a concern as is the presence of contaminants trapped in low spots of the lineset. R-410A associated with new 13 SEER condensers uses polyester oil (POE) rather than the mineral oil used with R-22. Therefore, if a replacement unit uses R-410A, any mineral oil left in the lineset from the R-22 refrigerant may slug the new compressor. Kinks or visible corrosion are also valid reasons for replacing the lineset. Regardless of how diligent the contractor is in sizing the unit, improper lineset sizing will lead to a loss of capacity and negatively impact the efficiency of the new condenser. In fact, the rebate offered by some utilities for 13 SEER units can be denied if proper line sizes are not used.

In the event a lineset and/or an evaporator coil cannot be replaced or a customer refuses to do so, it is a good idea to explain to the homeowner the relationship between the condensing unit and the

other components that comprise the HVAC system, emphasizing that they work together to achieve the rated efficiency of the condensing unit. This relationship makes compatibility and proper sizing of the units critical to the success of the system.

Then, if the decision remains not to replace the existing components, the contractor is faced with several daunting tasks that must be performed if a system is to approach its rated level of efficiency.

• First, perform an acid test and recover the refrigerant charge from the old system. If acid is present, flush out the lineset and coil with nitrogen and an EPA approved flushing agent.

• Remove the existing metering device from the evaporator coil and replace it with a thermostatic expansion valve. Since you will be working with an unmatched system, your best chance to avoid over or under feeding the coil is using a TXV that can adjust the refrigerant flow as conditions change.

• If acid was present, install an alumina activated suction line dryer in the suction line near the condensing unit. Remove it if the pressure drop across it reaches 3 psi or after 50 hours of run time, whichever comes first. Most new units ship with liquid line dryers installed at the factory. However, if the unit the contractor is servicing does not, one should be added. Remember, when brazing in the new unit and dryers(s), always run nitrogen through the lines to prevent copper scaling.

• Pressure test the system using nitrogen and a bubble solution. If the system is sealed, evacuate to below 500 microns. If it is not sealed and a leak exists, the vacuum level will rise to atmospheric pressure. In this case it becomes necessary to find and repair the leak, then repeat the vacuum process. A vacuum level that rises, but stabilizes below atmospheric pressure, points to the presence of non-condensables in the system. In this case, it becomes necessary to break the vacuum with nitrogen and repeat the process until the vacuum holds below 500 microns.

• With a matched system, weighing in the additional refrigerant charge makes this task quite easy. However, the disadvantage of an unmatched system means the amount required will only be an estimate.

• Start the system up, verify the achievement of airflow requirements, and allow the system to run for a minimum of 15 minutes. Determine the subcooling and adjust the charge as needed, using either a subcooling calculator or the actual manufacturer's performance charts. Again, a mismatched system means the charts will be estimates, at best, and as a result, the charge may not be adjusted properly to achieve the system's rated efficiency.

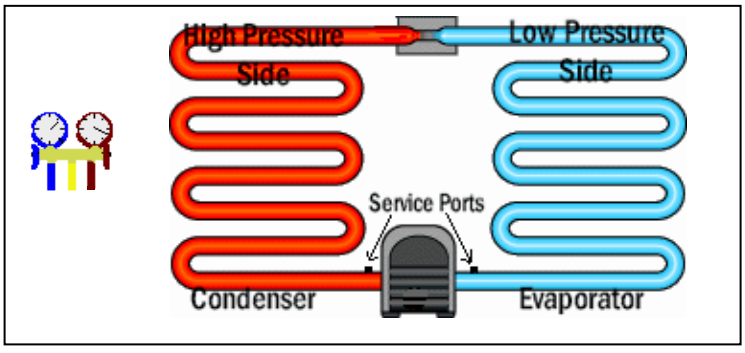
When a condensing unit has to be replaced and the entire HVAC system is properly considered, the contractor has the greatest opportunity to complete a successful job for a happy consumer. Asking homeowners appropriate questions and educating them on the operation of the new system, as well as the benefits of 13 SEER, will enhance that success. Finally, when the contractor delivers what they promise, which is an HVAC system that achieves efficiency, savings and comfort; it enhances the contractor's reputation, leaving them with a comfortable feeling as well.

In our Next Issue

Charging a Residential Air Conditioning System

Different types of metering devices have different ways of charging. A Thermostatic Expansion Valve (TXV) is charged to the sub-cooling of the liquid line leaving the condenser. A fixed orifice is charged to the superheat of the suction line leaving the evaporator. To understand why this is, it requires an understanding of the physical properties of the refrigeration cycle. The four main components of the refrigeration cycle include:

Compressor **Condenser**
Metering Devices **Evaporator**



These four components are divided into sections and explained along with proper methods of charging.

Evacuating your system

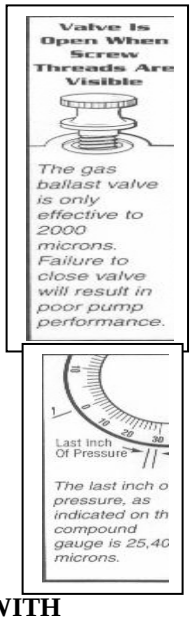
Hints Tips and Thoughts

AT THE BEGINNING OF EVACUATION WATER VAPOR IS QUICKLY REMOVED AND CAN CONTAMINATE THE PUMP OIL

WITH BALLAST VALVE OPEN A SMALL AMOUNT OF DRY AMBIENT AIR IS ADMITTED TO HELP PREVENT MOISTURE FROM CONDENSING IN THE OIL

A MICRON IS A MEASUREMENT OF PRESSURE STARTING FROM A PERFECT VACUUM

ONE INCH = 25,400 MICRONS MICRONS ARE MEASURED IN ABSOLUTE PRESSUE



SELECTING A VACUUM PUMP

- **PUMP CAPACITY HAS LITTLE TO DO WITH EVACUATION TIME**
- **BIGGER IS NOT ALWAYS BETTER**
- **THE REFRIGERATION SYSTEM HAS MANY RESTRICTIONS SUCH AS SMALL TUBING , METERING DEVICES, RETURN BENDS AND SERVICE PORTS WITH 3/16 " ORIFICES**
- **1-1/2 TO 10 CFM PUMP WILL HANDLE 99% OF OUR WORK**
- **Quick calculations state *CFM RATING SQUARED EQUALS MAXIMUM SYSTEM TONNAGE***
- **3 CFM PUMP = 3 CFM X 3 CFM = 9 TONS**
- **A 3 CFM PUMP WILL HANDLE UP TO 9 TONS**
- **MORE CFM = HEAVIER PUMP**

RECOMMENDED PUMP SPECS

- **2 STAGE**
- **ROTARY VANE**
- **BLANK-OFF VALVE**
- **GAS BALLAST VALVE**
- **1-1/2 – 10 CFM**
- **CAN PULL 300 TO 400 MICRONS**

HOOK UP TIPS

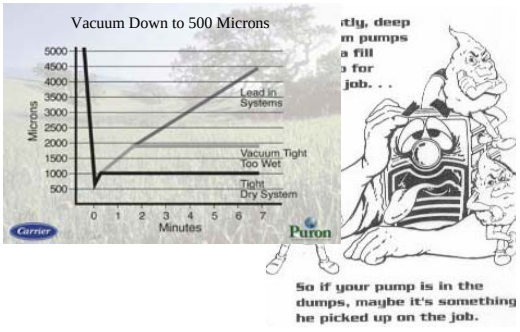
- **EVACUATE FROM BOTH SIDES OF THE SYSTEM**
- **SHORT CONNECTION LINES WILL SPEED UP EVACUATION**
- **IF YOU CONNECT THE VACUUM GAUGE TO THE ¼" FITTING ON PUMP YOUR LINE SHOULD BE AT LEAST 3'**
- **THE LOWEST READING IS AT THE PUMP. IF THE MICRON SENSOR IS AT THE PUMP WHEN WE BLANK-OFF THE MICRON GAUGE WILL FALL BACK TO ATMOSPHERIC PRESSURE**

EVACUATION PROCEDURE

- **CLOSE THE VACUUM PUMP SHUT OFF VALVE**
- **FULLY OPEN THE MANIFOLD VALVES + BALLAST VALVE**
- **START THE VACUUM PUMP. PERMIT TO PULL DOWN FOR A FEW MINUTES BEFORE OPENING THE SHUT OFF VALVE**
- **SLOWLY OPEN THE SHUT OFF VALVE. RAPID EVACUATION STARTS MAY FOAM THE COMPRESSOR OIL OR VACUUM PUMP OIL**
- **CLOSE BALLAST VALVE AFTER A FEW MINUTES**
- **EVACUATE UNTIL THE VACUUM GAUGE INDICATES 500 - 350 MICRONS OR LESS**
- **CLOSE THE SHUT OFF VALVE FOR A MINUTE. *IF SYSTEM PRESSURE DOES NOT INCREASE TO MORE THAN 500-650 MICRONS IN A MINUTE, EVACUATION IS ADEQUATEIF SYSTEM PRESSURE INCREASES TO 500 MICRONS IN LESS THAN ONE MINUTE, CONTINUE EVACUATION***
- ***CONTINUE EVACUATION UNTIL SYSTEM PRESSURE RISE FROM 350 TO 500 (150 microns) MICRONS TAKES ONE MINUTE OR MORE***

- ***CAUTION : CLOSE VACUUM PUMP SHUT OFF VALVE AND MANIFOLD VALVES BEFORE STOPPING THE VACUUM PUMP OR OIL FROM THE PUMP WILL FLOW INTO THE REFRIGERANT SYSTEM***

- ***Charts like the one aside are located in your installation manual Reference them as needed for proper evacuation procedures.***



CHANGE OIL OFTEN

PUMP OIL COLLECTS HYDROFLUORIC ACID, HYDROCHLORIC ACID & MOISTURE

OIL MUST BE CLEAN TO PULL A GOOD VACUUM

ALWAYS KEEP PUMP SEALED WHEN STORED