

Refrigerant-Charge Verification for Title 24 Energy Compliance: A Quick Guide for Contractors

THE IMPORTANCE OF REFRIGERANT-CHARGE

Most residential air conditioning (AC) systems undergo final assembly during installation. This is when the correct amount of refrigerant must be properly charged into the system to produce the manufacturer specifications of capacity (ability to cool) and efficiency (ability to cool while using a certain amount of electricity). The correct amount of refrigerant-charge required depends on a variety of factors, including: the size of the condenser, the size of the evaporator coil, and the size and length of the refrigerant lines.

An incorrect amount of refrigerant-charge can negatively impact the capacity and efficiency of the AC systems. An undercharged system, which is more common than an overcharged system, will perform like a smaller, less efficient unit, and therefore be less cost-effective. Overcharging can also greatly impact AC systems by reducing efficiency or even potentially damaging the compressor.

THIRD PARTY VERIFICATION: SAFETY MEASURE

Statewide studies¹ performed by the California Energy Commission (CEC) and major utilities found a number of refrigerant charge issues, including: refrigerants charged improperly as a result of poor installation; refrigerant lines with leaks and kinks; contaminants in the refrigerant; and, poor airflow across the coil commonly due to undersized ducts.

In response, Title 24 Energy Codes now require that when a new system is installed or an existing system has certain components replaced such as condensers or coils, the refrigerant must be tested by a HERS rater, a certified third party field inspector. If a system is properly charged, then it should pass a test administered by the HERS rater.

HERS raters are required to test refrigerant-charge using digital gauges and temperature probes calibrated

monthly. Digital gauges have shortened hoses with little chance for contamination by an incompatible refrigerant. HERS rater must also follow specific protocols when testing the charge.

To ensure the system is properly charged, it is recommended that the installer also test the charge using the same method as the HERS rater. HERS raters are not allowed to adjust the system; so, if the system does not pass, then the installer must make the necessary adjustments.

HERS RATERS QUALIFICATION AND CERTIFICATION

All HERS raters must be EPA 608 certified in addition to passing a rigorous state certified HERS rater certification training and exam. They are subject to regular quality assurance inspections by HERS providers (e.g., CalCERTS, USERA). Installers can contact HERS providers when HERS rater's qualifications or skill sets are questionable.

REFRIGERANT-CHARGE VERIFICATION TESTING

For thermal expansion valve (TXV) systems, which make up the majority of AC systems, the charge is tested using the sub-cool method.

Sub-cool is the number of degrees °F that the refrigerant cools down below the saturation temperature inside the condenser. The illustration on Page 2 shows the temperature of the refrigerant as it leaves the condenser (T_{liquid}) minus the saturation temperature inside the condenser ($T_{\text{sat, cond}}$). The saturation temperature in the condenser is essentially the temperature at which the refrigerant condenses from a gas into a liquid.

Saturation temperatures are difficult to measure directly, so using the chemical properties of the refrigerant they can be determined indirectly by taking pressures and using something called a pressure/temperature table.

¹ "Residential Refrigerant Charge Testing and Related Issues" CASE Study, 2011, CA IOU Codes and Standards Team

The manufacturer specified the target sub-cool, and the passing range is plus or minus several degrees of the target sub-cool (refer to CEC protocols for current range).

Once the proper charge has been established using the sub-cool method, the superheat is measured to ensure the TXV is operating properly.

Superheat is the number of degrees °F that the refrigerant warms up above the saturation temperature in the evaporator coil. In the diagram below - the superheat is the temperature of the refrigerant as it leaves the evaporator coil (T_{suction}) minus the saturation temperature inside the coil ($T_{\text{sat, evap}}$). The saturation temperature in the evaporator is essentially the temperature at which the refrigerant boils from a liquid into a gas.

The superheat passing range is a very wide range, and only poorly functioning TXVs will fail this test.

Note: for older systems without TXVs, the superheat method is used to determine proper charge. The superheat target is derived from a table found in Section RA3.2 of the Reference Appendices (see "For More Information") and differs from the target range mentioned above for testing the TXV operation.

If the outside temperature is too cold to perform the sub-cool or superheat method, the refrigerant-charge can be weighed-in in accordance with manufacturer

specifications as long as adjustments are made for line-set diameter and length. The CEC provides installation certificates specifically designed to document the weigh-in method. Unlike the sub-cool or superheat method, to count as a third party test, the HERS rater must be present to observe the refrigerant being weighed-in by the installer.

Another option is to hold off on the refrigerant-charge verification until the weather warms up. This is a good alternative because it lets the homeowner know that you care enough to do a proper refrigerant-charge under actual operating conditions. It may delay closing of the permit; however, some jurisdictions will close the permit as long as you sign a special form stating that you will return to complete the verification at a later date.

FOR MORE INFORMATION

For more information on refrigerant charge verification for Title 24 Energy Code compliance:

2013 Residential Compliance Manual Chapter 4 and flow chart in Appendix E. CEC publication # CEC-400-2013-001-CMF-REV2

2013 Reference Appendices Section RA3.2. CEC publication # CEC 400-2012-005-CMF-REV3

For more information about energy efficiency incentives available through SMUD, visit: <http://hpp.smud.org/> or email Jim Mills at: james.mills@smud

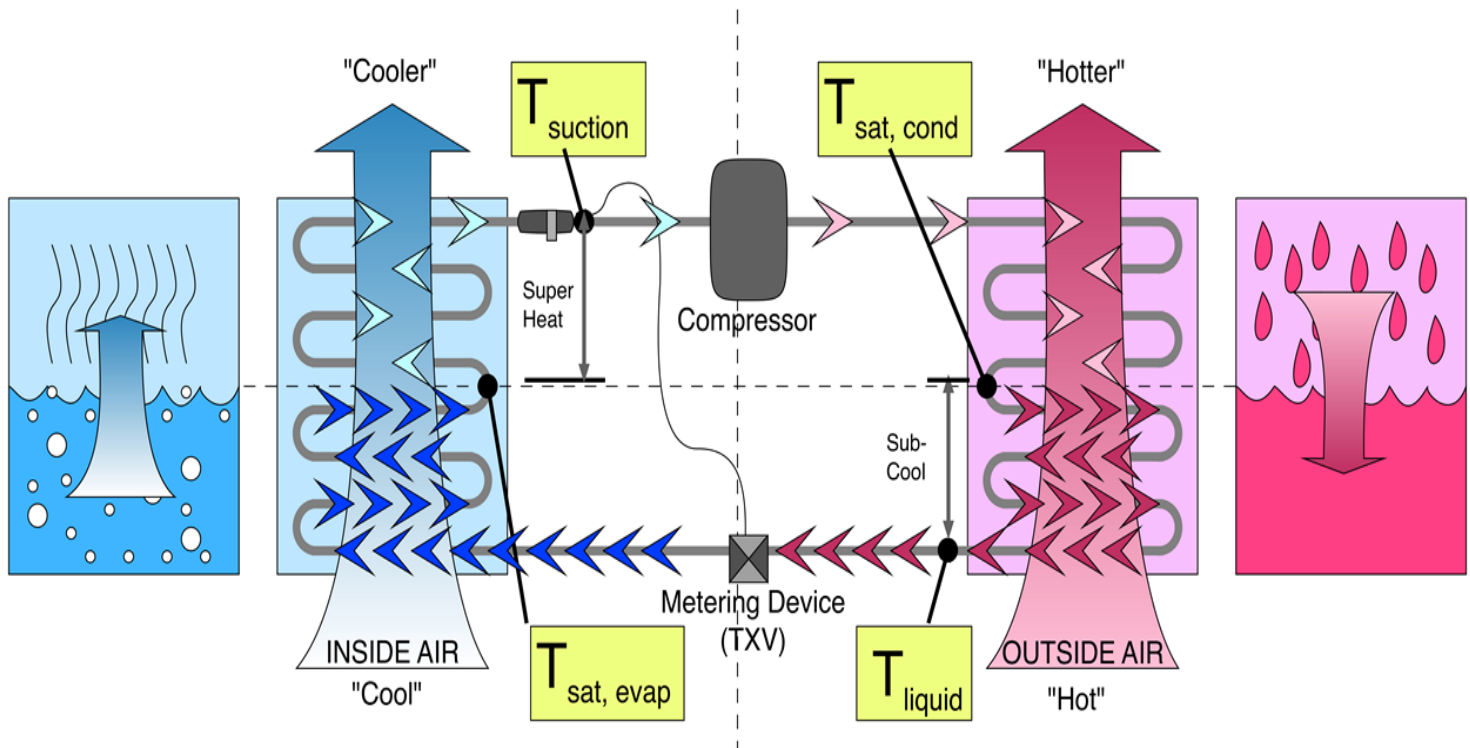


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