# A/C-Heat Pump System Troubleshooting Guide
# For the Testo 550

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**Before using this guide:**

**1) Make sure all filters, blower, and coils are clean. Verify all dampers are open.**
**2) Identify metering device and refrigerant type.**
**3) Measure and set required airflow at a nominal 400 CFM/Ton.**
**4) Determine required suction and liquid pressures using the design temperature difference. (DTD)**
**5) Test in cooling mode for heat-pumps**

*Typical design Evaporator DTD: (-35 °) @400CFM/Ton* *(1)*
*Typical design Condenser DTD: 6-8 SEER (+30°), 10-12 SEER (+25°), 13 SEER+ (+20°)*

Condenser pressures/temperatures will increase with indoor load

**RA Temp - Evap $_{DTD}$ = Evap Temp** Example: 75° RA - 35° DTD = 40° Evap Temp = 68.6 PSIG R22/118 PSIG R410a

**ODA Temp + Cond $_{DTD}$ = Cond Temp** Example: 95° ODA + 25° DTD = 120° Cond Temp = 260 PSIG R22 / 418 PSIG R410a

**Convert Evap and Cond temps to pressures with Temperature Pressure chart to obtain required pressures**

| System Problem (Fixed) | Suction Pressure | Liquid Pressure | Superheat | Subcooling | Amps | R/H Control |
|---|---|---|---|---|---|---|
| Refrigerant Overcharge | ↑ | ↑ | ↓ | ↑ | ↑ | Poor |
| Refrigerant Undercharge | ↓ | ↓ | ↑ | ↓ | ↓ | ICE/Poor |
| Liquid Restriction (Dryer) | ↓ | ↓ | ↑ | ↑ | ↓ | ICE/Poor |
| Low Evaporator Airflow (low load) | ↓ | ↓ | ↓ | ↓ | ↓ | ICE/Normal |
| Dirty Condenser | ↑ | ↑ | ↓ | ↓ | ↑ | Poor |
| Low Outside Ambient Temperature | ↓ | ↓ | ↑ | ↑ | ↓ | ICE/Normal |
| Inefficient Compressor$_{3}$ | ↑ | ↓ | ↑ | ↑ | ↓ | Poor |
| Non-Condensables | ↑ | ↑ | ↓ | Normal$_{6}$ | ↑ | Poor |

| System Problem (TXV) | Suction Pressure | Liquid Pressure | Superheat | Subcooling | Amps | R/H Control |
|---|---|---|---|---|---|---|
| Refrigerant Overcharge | Normal | ↑ | Normal | ↑ | ↑ | Normal |
| Refrigerant Undercharge | Normal$_{2}$ /↓ | ↓ | Normal$_{2}$ /↑ | ↓ | ↓ | ICE/Normal |
| Liquid Restriction (Dryer) | ↓ | ↓ | ↑ | ↑ | ↓ | ICE/Poor |
| Low Evaporator Airflow (low load) | ↓ | ↓ | Normal$_{4}$ | Normal | ↓ | ICE/Normal |
| Dirty Condenser | Normal | ↑ | Normal | Normal | ↑ | Normal |
| Low Outside Ambient Temperature | Normal$_{4}$ | ↓ | Normal$_{4}$ | Normal | ↓ | Normal |
| Inefficient Compressor$_{3}$ | ↑ | ↓ | ↑ | ↑ | ↓ | Poor |
| TXV Bulb Loose | ↑ | ↑ | ↓ | ↓$_{5}$ | ↑ | Poor |
| TXV Bulb Lost Charge | ↓ | ↓ | ↑ | ↑ | ↓ | ICE/Poor |
| TXV Bulb Poorly Insulated | ↑ | ↑ | ↓ | ↓ | ↑ | Poor |
| Non-Condensables | Normal | ↑ | Normal$_{4}$ | Normal$_{6}$ | ↑ | Poor/Normal |

**Notes:**

1) DTD figures are standard design values. Some manufactures have slightly different values that can be calculated from technical data
2) Superheat and suction pressure may appear normal under less than full load, may frost if charge is very low.
3) Pressures will equalize very quickly during off cycle
4) Valve might hunt to try and control load due to low load or flash gas entering the TXV
5) Could be appear normal if system overcharged
6) Has measurable sub-cooling but actually has none due to additive pressures in condenser.
Could show subcooling yet have bubbles in sight glass.

**TXV**

| | |
|---|---|
| Typical required subcooling | 8-12 degrees |
| Total superheat | 8-20 degrees |
| Evaporator superheat | 6-12 degrees |



**Fixed**

Consult charging chart for required superheat, subcooling will vary with load. Nominal subcooling at 95 degrees is typically 10 degrees.

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**Some Additional Tip/Tricks/Recommendations**

Always set/verify the evaporator airflow FIRST. You cannot properly charge any system without correct airflow. Make sure coils, filters and the blower are clean. On 90+ furnace applications do not forget to check the secondary heat exchanger for blockage. Look for problems with condenser air recirculation or clearances.

Always follow the manufactures charging procedures when available. (Note coils must be clean and evaporator airflow correct for pressure charging methods.)

Do not rush when charging a heat pump systems or any system with an accumulator. Do not add refrigerant to the system to quickly. Liquid refrigerant can build up in the suction accumulator and very slowly work its way out and into the condenser. At this point you may have significantly overcharged the system.

Watch both superheat and subcooling when refrigerant charging and troubleshooting. You cannot make any evaluations without checking both sides of the system.

Air-source heat pumps can only be charged accurately in the cooling cycle. If you must charge in the heating mode by pressure, the coils should be clean and the indoor airflow correct. You will need to return to verify the charge in the cooling season.

When charging fixed orifice systems use a target superheat calculator. Target superheat can range from 5 to 40° depending on indoor wet bulb and outdoor dry bulb conditions. Slide calculators are available for both R22 and 410a.

No A/C system can be properly operated or charged with evaporator coil temperatures below freezing. If the evaporator coil temperature (saturation temperature) is below 32°F, and the airflow is correct, it is to cold to properly charge the system. Typically when the wet bulb temperature is below 50° F or the return air dry bulb temperature is below 68°F there is not sufficient load to properly charge the system. If the temperatures fall within this specification and the coil is still too cold, check for air bypassing around the coil.

Typically for A/C TXV equipped systems to operate properly you must have a 100 psi drop across the metering device on R22 systems and a 160 psi drop across the metering device for 410a systems. If there is not sufficient drop for the TXV to operate properly, liquid will back up in the condenser. This will cause the suction pressure and liquid pressure will be lower than normal, the total and evaporator superheat higher than normal, and normal to high condenser subcooling will be present.

During periods of low outside ambient temperatures to verify proper TXV operation, block the condenser and raise the head pressure to the equivalent of a 90-95° F day then verify that the evaporator superheat and subcooling fall within the manufactures specifications. This procedure will not work for charging on systems that require you to charge by pressure only.

For TXV systems, subcooling changes only slightly with outdoor and indoor conditions. Typically there is only one subcooling value recommended by the manufactures for that reason. Always try to be within 3°F of the recommended value for optimal performance.

The TXV cannot control superheat after the sensing bulb. If the total superheat is too high for safe efficient operation, additional suction line insulation should be added to the line. Typically suction line temperatures over 55° F are cause of further examination.

Watch for mixed refrigerants. With the transition to 410a, this will be a common problem. To verify, remove the refrigerant into an empty evacuated recovery cylinder, let it set for 12-24 hours or until stable, and measure the tank temperature and compare it to the saturation temperature for that refrigerant. If it is not within 3-5 degrees, evacuate the system, change the dryer and recharge with new refrigerant. If in doubt, change it out. If you screw up and do it, fix it. The system will not work properly with mixed refrigerant. Consider a second set of gauges to avoid this problem.

Before you change out a TXV, verify correct sensing bulb location and mounting. The bulb requires metal connecting straps to secure it. Electrical tape or wire ties are not a secure connection. (Typically TXV's do not fail.)

Once the charge is correct, do not install your gauges on the system again during regular service unless you suspect a refrigerant problem. It is a sealed system, keep it that way. 95% of the problems you will encounter will be related to dirt and the need for maintenance.

Take the time to measure and verify the performance or capacity. An accurate airflow measurement and a wet bulb thermometer like the Testo 605-H2 is all you need. The formula is Btuh= 4.5 x CFM x Δh (Δh= Change in enthalpy, this can be found from a conversion table converting wet-bulb to enthalpy)