TECHNICAL SERVICE BULLETIN

DATE: 18, April 2005

SCOPE: Informative bulletin relating to Thermostatic Expansion Valve diagnostics

PURPOSE: TXV diagnostic and replacement guidelines.

Thermostatic Expansion Valves are used as a means of metering the refrigerant in many different types of refrigeration systems. ClimateMaster uses TXV's in most of our heat pump products. The purpose of a TXV is to meter the refrigerant through the evaporator to achieve a preset superheat at the TXV sensing bulb. Correct superheat of the refrigerant is important for the most efficient operation of the unit and for the life of the compressor. Therefore correct operation of the TXV is equally important.

Packaged heat pumps will typically use one BI-flow TXV to meter refrigerant in both modes of operation. ClimateMaster employs this method on all packaged heat pumps. When diagnosing possible TXV problems it may be helpful to reverse the refrigerant flow to assist with the diagnosis.

Geo-thermal and water source heat pumps are designed to operate through a wide range of entering water temperatures that will have a direct effect on the unit refrigerant operating pressures. Therefore diagnosing TXV problems can be difficult and uncertain. Through this bulletin ClimateMaster will attempt to offer some clarity and certainty when diagnosing possible TXV problems.

FAILURE: The most common failure mode of a TXV is for the valve to fail closed. Typically a TXV will use spring pressure to close the valve and an opposing pressure, usually from a diaphragm, to open the valve. The amount of pressure exerted by the diaphragm will vary depending on the pressure inside of the sensing bulb. As the temperature of, and therefore the pressure within, the bulb decreases the valve will modulate closed and restrict the refrigerant flow through the valve. The result is less refrigerant in the evaporator and an increase in the superheat. As the temperature at the bulb increases the diaphragm pressure will increase, opening the valve allowing more refrigerant flow and the superheat will be reduced.

If the sensing bulb, connecting capillary, or diaphragm assembly become damaged the pressure will be lost and the spring will force the valve to a closed position. The TXV will typically not close completely so some refrigerant flow will be normal although it will not be adequate flow for the heat pump to operate.

Placement of the TXV sensing bulb is also important. The sensing bulb will attempt to control the temperature of the line to which it is connected. Therefore the bulb must be properly located, secured, and insulated. The sensing bulb must be located on a dedicated suction line close to the compressor. On a heat pump this is the tube running from the compressor suction inlet to the reversing valve. On a packaged heat pump the bulb may be located almost any place on this pipe. If the bulb is located on a horizontal section the bulb should be placed in the 10:00 or 2:00 position for optimum performance.

The bulb must be secured to the pipe using a copper strap. Caution must be used when tightening the strap. The strap must be tight enough to hold the bulb securely but caution must be taken not to over-tighten the strap, which could dent, bend, collapse or otherwise damage the bulb. The use of heat transfer paste between the bulb and the pipe will also help insure optimum performance.

The bulb must also be properly insulated to eliminate any influence on the valve operation by the surrounding conditions. Cork tape is the recommended insulation as it can be molded tight to the bulb and sealed to prevent air infiltration.

CAUSES: There are any numbers of reasons why a TXV can fail. The most common causes are;

- Cracked, broken, or damaged sensing bulb or capillary. Can be caused by excessive vibration of the capillary during shipping or unit operation.
- ❑ **If the sensing bulb is damaged or if the capillary is cracked or broken the valve will be considered failed and must be replaced. Replacement of the TXV "power head" or sensing bulb, capillary, diaphragm assembly is possible on some TXV's. The power head assembly screws on to most valves but not all are intended to be replaceable. If the assembly is not intended to be replaceable ClimateMaster recommends replacement of the entire valve.**

- Particulate debris within the system. There are several possible sources including contaminated components, tubing, and service tools, or improper techniques such as during brazing operations and component replacement.
- ❑ **Problems associated with particulate debris can be compounded by refrigerant systems that use POE refrigerant oil. POE oil has solvent like properties that will clean the interior surfaces of tubing and components. Particulates can be released from interior surfaces and may migrate to the TXV strainer, which can lead to plugging of the strainer.**

- Corrosive debris within the system. May happen after a failure such as a compressor burn out if system was not properly cleaned.

- Non-Condensables in the system. Non-Condensables includes any substance other than the refrigerant or oil and can include air, nitrogen, or water. Contamination can be the result of improper service techniques, use of contaminated components, and/or improper evacuation of the system.

SYMPTOMS: The symptoms of a failed valve can be varied and will include one or more of the following;

- Low refrigerant suction pressure
- High refrigerant superheat
- High refrigerant sub cooling
- TXV and/or low pressure tubing frosting.
- Equalizer line condensing and at a lower temperature than the suction line or the equalizer line frosting.
- FP1 faults in the heating mode in combination with any of the symptoms listed above
- FP2 faults in the cooling mode in combination with any of the symptoms listed above

Some symptoms can mimic a failed TXV but may actually be caused be another problem. Before conducting an analysis for a failed TXV the following must be verified.

- Proper water flow and water temperature in the heating mode
- Proper airflow and temperature in the cooling mode.
- Coaxial water coil is clean on the inside. May require scale check. Applies to heating mode.
- Under charge of refrigerant. Perform sub-cooling and superheat calculations.

DIAGNOSTICS: When attempting to determine if a TXV is failed several tests or checks may be required. To properly conduct these tests the following tools may be required.

- Refrigerant gauge manifold compatible with the refrigerant in the system
- Digital thermometer, preferably with wire leads that can be connected directly to the tubing and insulated
- Refrigerant pressure-temperature chart for the refrigerant used

- ClimateMaster IOM for the model of unit being repaired
- ClimateMaster AOM for the CXM/DXM electronic heat pump control

To condemn a TXV as failed verify the following:

- The suction pressure is low and the valve is non-responsive. The TXV sensing bulb can be removed from the suction line and warmed by holding in your hand which should result in an increase in the suction pressure while the compressor is operating. The sensing bulb can also be chilled by immersion in ice water, which should result in a decrease in the suction pressure while the compressor is operating. No change in the suction pressure would indicate a non-responsive valve.

- The suction pressure is LOW **AND** the refrigerant sub-cooling is HIGH **AND** the superheat is high. LOW suction pressure, LOW sub-cooling and HIGH superheat May indicate an under charge of refrigerant. HIGH sub-cooling and LOW superheat may indicate an over charge of refrigerant. The suction pressure will usually be normal or high if there is an over charge of refrigerant.

- The suction pressure is LOW and frosting of the valve and/or equalizer line may indicate a failed valve but may also be an indicator of an under charge of refrigerant. Calculate the sub-cooling and superheat to verify a failed valve or refrigerant charge issue.

REPAIR:

- **IMPORTANT: Repair to any sealed refrigerant system requires training in the use of refrigeration tools and procedures. Repair should only be attempted by a qualified service technician. A universal refrigerant-handling certificate will always be required. Local and/or state license or certificate may also be required.**

- **IMPORTANT: Always know what type of refrigerant is in the system. Alternate refrigerants such as the EarthPure R410A refrigerant require approved tools that are dedicated to these refrigerants. Many alternative refrigerants require the use of synthetic lubricants such as POE oil. Contamination from mineral oil can occur if tools used with refrigerants such as R22 are used.**

- **WARNING: Alternative refrigerants may operate at higher pressures than refrigerants such as R22. Tools such as manifold gauges must be rated to withstand the higher pressures. FAILURE TO USE APPROVED TOOLS MAY RESULT IN A VIOLENT FAILURE OF THE TOOL(S), WHICH CAN LEAD, TO SEVERE DAMAGE, INJURY, OR DEATH.**

- **IMPORTANT: Due to the hygroscopic nature of the POE oil in EarthPure and other environmentally friendly refrigerant systems any component replacement must be conducted in a very timely manner using caution and proper service procedure for these types of refrigerants. A complete installation instruction will be included with each replacement TXV/filter-drier assembly. It is of critical importance these instructions are carefully understood and followed. Failure to follow these instructions can result in a system that is contaminated with moisture to the extent several filter-drier replacements may be required to properly dry the system.**

- **CAUTION: Always recover the refrigerant from the system with suitable approved tools, recovery equipment, and practices prior to attempting to remove or repair any TXV.**

- **NOTE: Most ClimateMaster TXV's are designed for a fixed superheat setting and are therefore considered non-adjustable. Removal of the bottom cap will not provide access for adjustment and can lead to**

damage to the valve or equipment, unintended venting of refrigerant, personal injury, or possibly death.

For further information contact the ClimateMaster Technical Service Dept. at 800-299-9747.

- Use the table below to determine proper unit operating pressures and temperatures. At some conditions low refrigerant suction pressure may be normal. Chart is for model GS/GR heat pumps. Other models may vary. Refer to unit IOM for different models.

Table 7: Typical Unit Operating Pressures and Temperatures

		Cooling**						Heating -					
Entering Water Temp °F	Water Flow GPM/ton	Suction Pressure PSIG	Discharge Pressure PSIG	Super-heat	Sub-cooling	Water Temp Rise °F	Air Temp* Drop °F DB	Suction Pressure PSIG	Discharge Pressure PSIG	Super-heat	Sub-cooling	Water Temp Drop °F DB	Air Temp* Rise °F
30	1.5	75-85	90-105	25-40	12-20	21-24	21-26	34-39	167-186	12-16	1-4	7.6-8.4	14-20
	2.3	74-84	80-95	25-40	11-18	13-16	21-26	37-43	172-191	12-16	1-4	4.8-5.6	16-22
	3.0	73-83	70-85	25-40	10-16	6-11	21-26	40-46	177-196	12-16	1-4	3.4-4.2	16-22
50	1.5	75-85	125-155	12-20	10-18	20-23	20-25	50-60	180-210	10-17	1-5	10.8-11.9	23-29
	2.3	74-84	120-142	12-20	9-16	12-15	20-25	53-62	186-215	10-17	1-5	6.7-8.1	24-30
	3.0	73-83	115-138	12-20	8-14	8-12	20-25	55-65	190-220	10-17	1-5	5.1-5.9	25-31
70	1.5	75-85	179-198	9-16	8-15	19-22	19-24	71-82	205-230	14-19	1-5	14.0-15.2	28-34
	2.3	74-84	168-186	9-16	8-14	12-17	19-24	73-85	210-238	14-19	1-5	9.0-10.2	30-37
	3.0	73-83	158-175	9-16	8-12	7-12	19-24	76-88	215-242	14-19	1-5	6.7-7.9	31-38
90	1.5	75-85	229-251	9-17	8-15	18-21	17-23	85-95	220-260	18-28	2-5	14.4-16.6	32-39
	2.3	74-84	218-241	9-17	8-14	10-14	17-23	90-100	225-265	18-28	2-5	10.8-12.4	33-41
	3.0	73-83	208-230	9-17	8-12	6-11	17-23	95-105	230-270	18-28	2-5	7.2-8.3	35-42
110	1.5	77-87	280-320	8-15	10-25	17-20	15-20						
	2.3	76-86	270-310	8-15	10-24	9-13	15-20						
	3.0	75-85	260-300	8-15	10-22	5-10	15-20						

HWG should be disabled for accurate chart comparison.
*Based on Nominal 400 cfm per ton (54 l/s per kw) airflow and 70°F (21°C) EAT htg and 80/67°F (26.7/19.4°C) EAT cooling.
**Cooling air and water numbers can vary greatly with changes in humidity.
Subcooling is based upon the head pressure at compressor service port.

WATER SOURCE HEAT PUMP TXV TROUBLESHOOTING GUIDE

SYMPTOM	HTG	CLG	CAUSE	DIAGNOSIS/REPAIR
Low refrigerant suction pressure	X		Normal Operation	Check/compare with unit IOM typical operating temperatures and pressures chart
	X		Reduced water flow	Check pump operation
				Check strainer or filter
				Improper flow regulator
	X		Water temperature out of range	Bring water temperature within proper range
	X		Scaling in water to refrigerant heat exchanger	Conduct water quality analysis
		X	Reduced air flow	Check for dirty air filter
				Check for dirty air coil
				Check fan motor operation
				External static pressure exceeds fan operating parameters
	X	X	Return air temperature below minimum	Space temperature to cold
				Excessive fresh air
		X		Supply air bypassing to return air stream (zone systems)
	X	X	Insufficient refrigerant charge	Locate and repair leak
				Conduct superheat and subcooling analysis
	X	X	Failed or restricted metering device	Failed TXV power head, capillary, or sensing bulb
				Plugged TXV strainer
High refrigerant superheat	X	X	Insufficient refrigerant charge	Locate and repair leak
	X	X	Improperly located TXV sensing bulb	Locate bulb on suction line between reversing valve and compressor
	X	X	Failed or restricted metering device	Failed TXV power head, capillary, or sensing bulb
				Plugged TXV strainer
High refrigerant sub cooling	X	X	Excessive refrigerant charge	Remove refrigerant as needed
			Failed or restricted metering device	Failed TXV power head, capillary, or sensing bulb
				Plugged TXV strainer
TXV and/or low pressure tubing frosting.	X		Normal operation	May occur when Entering water temp is close to minimum
	X	X	Insufficient refrigerant charge	Locate and repair leak
	X	X	Failed or restricted metering device	Failed TXV power head, capillary, or sensing bulb
				Plugged TXV strainer
Equalizer line condensing or frosting.	X	X	Failed or restricted metering device	Failed TXV power head, capillary, or sensing bulb
				Plugged TXV strainer