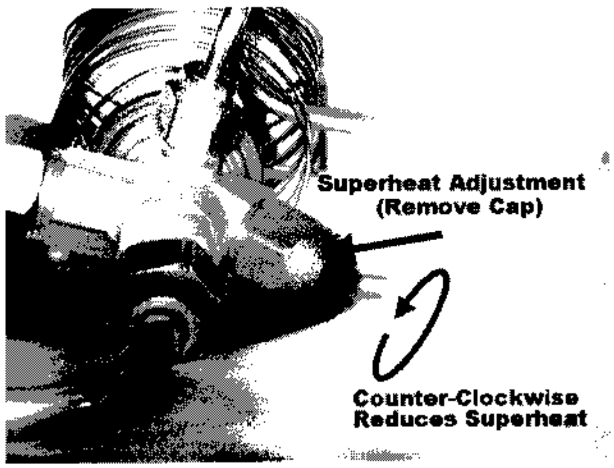
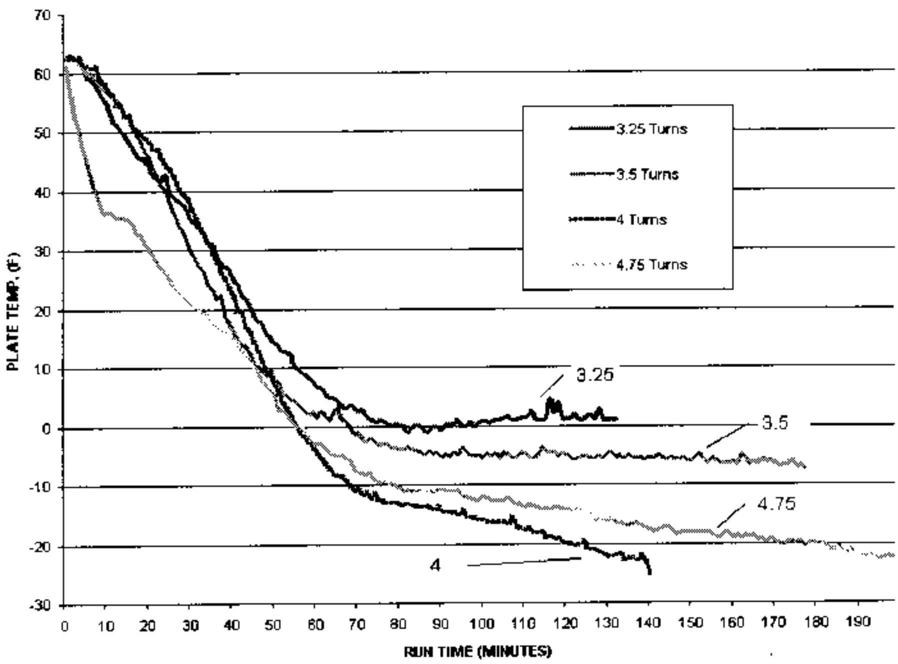
ADJUSTING SUPERHEAT



"Superheat" is the term used to describe the difference between the *vapor point* (ie. temperature at which the refrigerant evaporates at a given pressure) and the actual temperature of the refrigerant exiting the evaporator coil. The "superheat"is regulated by the Thermostatic Expansion Valve (TXV). An adjustment on the valve compares the pressure (and, subsequently, temperature) within the evaporator tubing (inside the holding plate) to the temperature of the tubing at the point where it exits the plate (as measured by the expansion valve sensing bulb).The TXV constantly compares the temperature of the evaporator coil inside the plate with the temperature outside the plate. It then automatically adjusts (opening and closing) to meter in just the right amount of refrigerant for any heatload condition.

By turning an adjustment screw at the back of the TXV, you are telling the valve to maintain a particular temperature difference between the inside of the evaporator coil and the temperature outside the plate. This adjustment is very sensitive and must be "tuned" to each system and installation to obtain optimum performance.

The chart below is taken from a Whisper Jet compressor unit freezing down a single #3 freezer holding plate and shows the dramatic effect of very small changes in the superheat adjustment screw.



The number of "turns" (chart legend) refers to the number of turns "in" (ie. "clockwise") when starting with the adjustment screw turned completely "out" (ie. turned counter-clockwise until it stops). *The factory default setting is 3.5 turns "in" (ie. clockwise) from the fully counter-clockwise position.*

Things to Notice About The Chart:

- Higher numbers (ie. more "turns") means higher superheat. Higher superheat puts less refrigerant into the evaporator.
- The TXV manufacturer's default setting of 3.5 turns would not permit the holding plate to get colder than -8^0 F.
- Decreasing the superheat (adding more refrigerant) by .25 turns (to 3.25) made the problem much worse.
- Increasing the superheat (reducing the amount of refrigerant) by .5 turns (to 4 turns) greatly improved the performance and allowed the plate to quickly freeze down.
- Increasing the superheat further (to 4.75 turns) reduced the performance substantially but still allowed the plate to freeze down (over a much longer time).

Setting The Superheat On Your System
Note: The superheat adjustment on the freezer plate(s) is much more sensitive than on the refrigerator plates. The refrigerator generally gives satisfactory performance over a much wider adjustment range.

The preceding chart is provided as a general example of how various superheat settings effect a system. In this particular system, 4 turns in was the ideal adjustment setting for the freezer valve - your optimum setting is likely to be different.

Below, two methods are described for setting the superheat on your TX valves. *Method #1 - Observation,* **is intended for freezer plate only** does not require gauges or a separate thermometer. It gives very accurate results but is somewhat time-consuming. *Method #2 - Direct Measurement* can be used for both refrigerator and freezer TXV adjustment and is the method most often used by refrigeration servicemen since it gives acceptable results and is faster than Method #1.

Warning: Do not attempt to adjust the superheat based on the "frost line" of the suction return tubing. Contrary to what you may have heard from confused technicians, the "frostline" is largely irrelevant. Generally, if a Glacier Bay system develops frost on the suction line between the R/A/D assembly and the compressor, it is a good indicator that the superheat setting (on at least one TXV in a multi-plate zone) is too low. Beyond that, accurate adjustment cannot be made based on the length of the frostline.

<u>Multiple Plates In One Zone</u>
Many systems have two (or more) holding plates in single zone. Whenever there are multiple plates pulling-down at the same time (ie. same "zone") it is desirable to adjust only one TXV at a time. To do this, turn the superheat adjustment screw fully "IN" (ie. clockwise - maximum superheat) on the plate(s) that you are <u>NOT</u> adjusting - DO NOT FORCE THE SCREW. This will ensure that the setting of this valve(s) does not interfere with the valve you are attempting to adjust. Also, if you are using Method #1 - you must move the thermostat/ECM temperature probe into the well of the plate being adjusted. Be sure the probe is properly sealed to ensure an accurate reading (see the Installation Manual). After the first valve is adjusted, carefully count the number of turns it takes to get back to the fully out (counter-

clockwise) "stop". Write that number down so the valve can be reset to the correct place after the other valves are adjusted. Now, turn the screw all the way "IN" and proceed to the next valve adjustment. After all valves are adjusted, reset them to the correct position by turning them the correct number of turns "IN" from the fully "OUT" (stop) position.

To Adjust The Superheat, You Will Need The Following Tools:

1. Refrigerant gauge set (Method #2 only)
2. 19mm socket or wrench (Method #1 & #2)
3. Flathead screw driver (Method #1 & #2)
4. Temperature/Pressure table for HFC-134a (Method #2 only, located elsewhere in this Manual)
5. Accurate surface reading thermometer (Method #2 only)

Method #1 - Observation (Freezer Plates only)

This method is based on the idea that the "optimum" superheat setting for freezer plates is usually the least superheat (ie. most refrigerant) that can be set while still permitting the plate to freeze down very cold (typically -20° to -25° F). As can be seen in the chart (presented above), too little superheat prevents the plate from ever reaching the correct temperature while too much superheat requires the compressor to run excessively long to attain a low temperature.

Therefore, the idea is to intentionally set the super heat too low (thus preventing the plate from freezing all the way down), then slowly increase the superheat to the point where the plate temperature begins coming down as it should. To use Method #1:

- Select the TXV/plate to be adjusted. Remove the cap covering the superheat adjustment screw.
- Make sure the thermostat/ECM temperature probe is in the plate well and properly sealed
- Make sure the TXV sensing bulb is securely clamped using the strap provided or a metal hose clamp (no nylon wire ties).
- Turn the adjustment screw fully counter-clockwise (out) until it stops. Then turn it clockwise (in) exactly three (3) turns.
- Turn on the compressor and let it run. Allow the plate to reach its lowest temperature. The temperature is likely to be higher than that desired and fluctuate within a narrow temperature range (see previous chart). Allow it stabilize at this temperature for 15-30 minutes.
- With the compressor still running, turn the superheat adjustment screw "IN" (clockwise) 1/4 turn. Allow the system run until the temperature again reaches its minimum. *Very Important - The system must run for a minimum of 15 minutes before making any further adjustment.*

- Repeat the previous step adjusting the screw IN 1/4 turn at a time and allowing the temperature to fully stabilize at its minimum temperature (or 15 minutes - whichever is longer) after each adjustment. (Do not make further adjustment if the plate temperature is continuing to fall) Repeat the process until the plate reaches -20° to -25° F.

Note: The temperature of you plate may actually RISE as you begin to make your 1/4 turn adjustments in - this is OK. Simply continue to make the adjustments being sure to wait at least 15 minutes. At a critical adjustment, the temperature will begin falling.

Method #2 - Direct Measurement

This method involves the actual measurement and calculation of the superheat. It is highly accurate with the right tools but can be very misleading if the wrong thermometer or an inaccurate pressure gauge is used. This method is suitable for both refrigerator and freezer plates.

Measuring Superheat

The adjustment process should be started when the holding plate is approximately 1/2 frozen. If the plate is fully thawed, allow the system to partially freeze down before taking your measurements.

Step 1- Ensure that the sensing bulb for the thermostat is firmly clamped to the suction line on a horizontal tubing run at the 10:00 or 2:00 position.

Step 2 - Remove the protective cap covering the superheat adjustment screw.

Step 3 - Connect the refrigerant gauge set and purge. Only the suction side need be connected. It is a good idea to re-calibrate your gauge to "0" before connection.

Step 4 - Securely attach the thermometer probe to the suction line immediately after the manifold elbow and fitting.

Step 5 - Start compressor and allow the system to run at least 10 minutes to stabilize.

Step 6 - Determine suction line pressure drop.

The suction side pressure you are reading at the compressor includes line losses as the refrigerant gas makes its way back to the compressor. To accurately determine the superheat we need to know the suction pressure *at the evaporator*. Therefore, we need to determine, and then add back in, any additional pressure drop which occurs between the evaporator and the compressor. Fortunately, this loss can be easily seen on the pressure gauge as an immediate "jump" at the moment the compressor is turned off. Typically, line pressure drop will only amount to 1 or 2 psi. However, with long tubing runs it may be higher. Manually turn the compressor off and on a couple of times to determine the pressure drop in your system. Once determined, leave the compressor running.

Step 7 - Determine the evaporator temperature.

Do this by reading your suction pressure displayed on the gauge and adding back in the line pressure drop. Use your temperature/pressure table to determine the actual evaporator temperature. For example: gauge reading (10 psig) + line loss (2 psi) = 12 psig. The temperature/pressure table tells us that HFC-134a has a vapor point (evaporator temperature) of 10^0 F at 12 psig. Therefore, the system evaporator temperature is 10^0 F.

Step 8 - Measure evaporator exit temperature.

Use your surface reading thermometer to read the temperature of the suction line at the holding plate exit point. For example: 18^0 F.

Step 9 - Calculate superheat.

Evaporator exit temperature (18^0 F) - evaporator temperature (10^0 F) = 8^0 F superheat.

Changing Superheat

To change the superheat setting, turn the flathead adjustment screw *clockwise to increase* the superheat, *counter-clockwise to decrease.* Adjust the screw no more than 1/4 turn at a time and allow the at least 15 minutes running before re-measuring. Large adjustments and fine-tuning must sometimes be done over several "pull-down" cycles because of the amount of compressor run time required to stabilize the system after each adjustment.

Superheat Adjustment Q&A

Q- *New laws enforce a world-wide requirement that only properly licensed service technicians (complete with recovery equipment "on-site" at all times) may perform certain operations. Does the adjustment of superheat fall into this category?*

A - Method #1 described above does not require a license, Method #2 does. These laws apply anytime it is necessary to "break into the refrigerant stream". Unless you have permanently mounted gauges, you will need to connect them into place to follow Method #2. By doing so, you then fall under the regulations. In the US, fines up to $50,000 are now being regularly issued.

Q - *If the "frostline" is irrelevant as you say, why does my refrigeration serviceman always talk about it when referring to superheat settings?*

A - Unfortunately, in spite of the fact that proper superheat adjustment in vital to the efficient operation of any refrigeration system, most marine servicemen have only a vague understanding of it. Many do know, however, that severely low superheat can cause physical damage to the compressor (don't worry - your Glacier Bay system is protected from such damage). An easy "rule-of-thumb" which ensures that the superheat is not set so low as to cause such damage is to adjust it until the "frost-line" is some distance from the compressor. While this practice does safeguard the compressor from damage it often, particularly in the case of freezer plates, gives in a superheat setting which is much too high. The result is inefficient operation and excessive compressor run time.

Q - *Does under and/or overcharging effect superheat?*

A - Yes and No. In the case of capillary tube systems (typically low-cost direct expansion systems), superheat adjustment in the field is accomplished entirely by the amount of the charge. However, in expansion valve systems (including all Glacier Bay systems), the superheat would only change (increase) in the case of very severe under-charging. Over-charging does cause other problems but never changes the superheat in an expansion valve system.

Q - *Since the superheat setting has very little latitude for error, how do I know that the gauge and thermometer are accurate enough for Method #2?*

A - Most analog (dial type) refrigeration gauges are surprisingly accurate if they have not been abused and have been re-calibrated to "0" before pressure is applied. Thermometers, even very expensive ones, can be problematic. If possible, try to cross-check with another thermometer or two *at the temperatures you expect to be reading.*

Q - *I have a gauge set with a temperature scale for HFC-134a, can I use that instead of the temperature/pressure table?*

A - No. It isn't going to be accurate enough. Use the one provided in the Glacier Bay Installation Manual Appendix or on the Glacier Bay website.

The Temperature/Pressure Table for HFC-134a

Pressure is given in PSIG (gauge) and the temperature in degrees F.
To convert PSIG to "Bar" multiply by .06895
To convert °F to °C subtract 32 then divide by 1.8

Pressure [psig]	Temp [F]	Pressure [psig]	Temp [F]	Pressure [psig]	Temp [F]
(22")	-62.38	27	31.10	65	65.71
(20")	-55.02	28	32.27	66	66.43
(18")	-48.85	29	33.43	67	67.14
(16")	-43.50	30	34.56	68	67.85
(14")	-38.76	31	35.68	69	68.55
(12")	-34.49	32	36.77	70	69.24
(10")	-30.60	33	37.85	75	72.62
(8")	-27.02	34	38.91	80	75.86
(6")	-23.70	35	39.96	85	78.98
(4")	-20.59	36	40.99	90	81.97
(2")	-17.67	37	42.00	95	84.87
0	-14.92	38	43.00	100	87.66
1	-12.31	39	43.98	105	90.37
2	-9.83	40	44.95	110	92.99
3	-7.47	41	45.91	115	95.53
4	-5.21	42	46.85	120	98.00
5	-3.04	43	47.78	125	100.4
6	-0.95	44	48.70	130	102.7
7	1.05	45	49.61	135	105.0
8	2.99	46	50.51	140	107.2
9	4.86	47	51.39	145	109.4
10	6.67	48	52.26	150	111.5
11	8.42	49	53.13	155	113.6
12	10.12	50	53.98	160	115.6
13	11.77	51	54.82	165	117.6
14	13.38	52	55.65	170	119.6
15	14.94	53	56.48	175	121.5
16	16.46	54	57.29	180	123.3
17	17.95	55	58.10	185	125.2
18	19.40	56	58.89	190	126.9
19	20.81	57	59.68	195	128.7
20	22.19	58	60.46	200	130.4
21	23.55	59	61.23	205	132.1
22	24.87	60	62.00	210	133.8
23	26.16	61	62.75	215	135.5
24	27.43	62	63.50	220	137.1
25	28.68	63	64.24	225	138.7
26	29.90	64	64.98	230	140.2