

SUPERHEAT/SUBCOOLING

Saturated Refrigerant

A refrigerant which exists in a gas (vapor) **and** liquid form, in the same place, at the same time is said to be saturated. Refrigerant is saturated throughout much of the evaporator and condenser.

Saturated refrigerants adhere to the temperature/pressure chart for the refrigerant in use. Non-saturated refrigerants (100% vapor and 100% liquid) do not adhere to the temperature/pressure chart for a given refrigerant.

Example: you determine that the pressures in the condenser and evaporator are 242 psig and 69 psig respectively. The refrigerant is R-22. Using a temperature/pressure chart (also called a saturation chart) you determine that the saturated condensing temperature (SCT) is 114°F and the saturated suction temperature (SST) is 40°F. Said another way, the refrigerant is changing from gas to liquid (condensing) in the condenser at a temperature of 114°F, and changing from a liquid to gas in the evaporator (evaporating) at 40°F. *See the chart on page 3.*

Superheat

Heat which is added to a refrigerant vapor after all of the liquid refrigerant has been boiled away is called superheat. Superheat occurs in the evaporator coil and ensures that no liquid refrigerant leaves the evaporator coil and enters the compressor. This is important because compressors cannot pump liquid — they are designed to pump vapor only.

Superheat is often the preferred method to check refrigerant charge on capillary tube or fixed restrictor metered evaporators. These systems measure superheat in the suction line at the condensing unit.

You **cannot check charge on a thermostatic expansion valve (TXV)** system using superheat unless specifically instructed to do so by the manufacturer—TXV's control superheat.

Superheated refrigerant can also be found in the discharge line (hot gas) leaving the compressor and entering the condenser.

Superheat is measured using the following relationship:

$$\text{SH} = \text{SLT} - \text{SST}$$

WHERE:

SH = Superheat

SLT = Suction line temperature

SST = Saturated suction temperature

Subcooling

Heat which is removed from a refrigerant liquid after all of the vapor has condensed into a liquid is called subcooling. Subcooling occurs in the condenser and ensures that no vapor leaves the condenser. If 100% liquid leaves the condensing coil and enters the metering device this maximizes metering device performance and system capacity. Subcooling is measured in the liquid line at the condensing unit.

Subcooling in the condenser can be used to charge TXV (Thermostatic Expansion Valve) controlled systems.

Subcooling is calculated using:

$$SC = SCT - LLT$$

WHERE:

SC = Subcooling

SCT = Saturated condensing temperature

LLT = Liquid line temperature leaving the condenser

Summary

Follow all manufacturer and industry safety practices and procedures.

Always follow manufacturer's instructions for charging air conditioning units — they will be the most accurate. If their instructions are not on the unit and/or are no where to be found on the job-site, determine the metering device type and read on.

Fixed restrictor or capillary tube — charge the system using the superheat method. A superheat chart is available at our website. Use the chart to determine the correct superheat for your conditions by first finding the load on the evaporator and condenser. If you need help, we cover this procedure in detail at our Air Conditioning I (The Basics) seminar.

TXV— charge the system using the subcooling design for the condenser. This data is available on the rating plate on modern condensing units. We cover this procedure in another of our courses, Air Conditioning II (Intermediate A/C).

Remember, only EPA ***608** certified personnel are to service and/or install equipment where the potential for refrigerant release exists.

Type I Certification allows a person to service small appliances ONLY.

Type II Certification allows a person to service all stationary systems except small appliances and low pressure systems.

Type III Certification allows a person to service low pressure appliances such as low pressure chillers.

A person holding Type I, II, and III certifications is classified as “**Universally Certified**” and they can service any of the above. See www.epa.gov for details.

**608 certification is for stationary air conditioner, heat pump, and refrigeration units ONLY. 609 certification is required for mobile systems such as auto or truck air conditioners, train or semi mounted refrigeration units and air conditioners, etc.*

Penalties for working on systems without the proper certification are severe: up to \$27,500 per day per violation. Behler-Young has several certification courses with exams—

visit www.behler-young.com

- Instructor -

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CORRESPONDING TEMPERATURES AND PRESSURES

START

REFRIGERANT PRESSURES, PSI GAUGE

TEMPERATURE °F	R-12	R-22	R-500
25	24.6	49.0	31.6
26	25.4	50.2	32.5
27	26.1	51.5	33.3
28	26.9	52.7	34.3
29	27.7	54.0	35.2
30	28.4	55.2	36.1
31	29.3	56.5	37.0
32	30.1	57.8	38.0
33	30.9	59.2	39.0
34	31.7	60.5	40.0
35	32.6	61.9	41.0
36	33.4	63.3	42.0
37	34.3	64.6	43.1
38	35.2	66.1	44.1
39	36.1	67.5	45.2
40	37.0	69.0	46.2
41	37.9	70.5	47.2
42	38.8	72.0	48.4
43	39.7	73.5	49.6
44	40.7	75.0	50.7
45	41.7	76.6	51.8
46	42.6	78.2	53.0
47	43.6	79.8	54.2
48	44.6	81.4	55.4
49	45.7	83.0	56.6
50	46.7	84.7	57.8
52	48.8	88.1	60.3
54	50.9	91.5	62.9
56	53.1	95.1	65.5
58	55.4	98.8	68.2
60	57.7	102.5	71.0
62	60.1	106.3	73.8
64	62.5	110.2	76.7
66	65.0	114.2	79.7
68	67.5	118.3	82.7
70	70.2	122.5	85.8
72	72.9	126.8	89.0
74	75.6	131.2	92.3
76	78.4	135.7	95.6

CONTINUED

REFRIGERANT PRESSURES, PSI GAUGE

TEMPERATURE °F	R-12	R-22	R-500
78	81.2	140.3	99.0
80	84.2	145.0	102.5
82	87.2	149.8	106.1
84	90.2	154.7	109.7
86	93.3	159.8	113.4
88	96.5	164.9	117.3
90	99.8	170.1	121.2
92	103.1	175.4	125.1
94	106.5	180.9	129.2
96	110.0	186.5	133.3
98	113.5	192.1	137.6
100	117.2	197.9	141.9
102	120.9	203.8	146.3
104	124.6	209.9	150.9
106	128.5	216.0	155.4
108	132.4	222.3	160.1
110	136.4	228.7	164.9
112	140.5	235.2	169.8
114	144.7	241.9	174.8
116	148.9	248.7	179.9
118	153.2	255.6	185.0
120	157.6	262.6	190.3
122	162.2	269.8	195.8
124	166.8	277.1	201.3
126	171.5	284.4	206.8
128	176.2	291.9	212.5
130	181.0	299.3	218.2
132	186.0	307.4	224.2
134	191.0	315.5	230.2
136	196.1	323.9	236.3
138	201.4	332.6	242.6
140	206.6	341.3	248.8
142	212.1	350.4	255.4
144	217.6	359.5	261.9
146	223.2	368.6	268.6
148	228.9	377.9	275.5
150	234.6	387.2	282.3
155	249.5	410.8	300.1
160	264.4	434.4	317.9