Appendix L – Procedures for Determining Required Refrigerant Charge and Adequate Airflow for Split System Space Cooling Systems without Thermostatic Expansion Valves

Note: This Appendix is included in the Residential ACM Approval Manual as Appendix K. This appendix is intended to duplicate the material in the ACM Approval manual (except for table numbering and table references). It is provided here for the convenience of the reader. If there are any discrepancies between the two documents, the ACM Approval Manual has precedence.

Overview

Failure to maintain proper refrigerant charge or proper airflow across the coil reduces the seasonal energy efficiency for an air conditioner (whether a cooling only air conditioner or a heat pump). In addition, excessive refrigerant charge can cause premature compressor failure, while insufficient refrigerant charge allows compressors to overheat. Very low airflow can result in icing of the coil and compressor failure.

To help avoid these problems and to provide a compliance credit for correctly installed systems, this appendix describes procedures for determining if a residential split system space cooling system has the required refrigerant charge and adequate airflow across the evaporator coil. The applicability of these procedures have the following limitations:

- The procedures detailed in this appendix only apply to ducted split system central air conditioners and ducted split system central heat pumps that do not have thermostatic expansion valves (TXVs).
- As an alternative to the procedures detailed in this appendix, systems may substitute a TXV installed and confirmed through field verification and diagnostic testing.
- The procedures detailed in this appendix do not apply to packaged systems.

Note that the procedures detailed in this appendix are intended to be used after the HVAC installer has installed and charged the system in accordance with the manufacturer's specifications. For homes with multiple systems, this procedure must be applied to each system separately.

This appendix defines two procedures, the Standard Charge and Airflow Measurement procedure in Section 2 and the Alternate Charge and Airflow Measurement procedure in Section 3. The Standard procedure shall be used when the outdoor air temperature is 55°F or above and shall always be used for HERS rater verification. HVAC installers who must complete system installation when the outdoor temperature is below 55°F shall use the Alternate procedure.

The following sections document the instrumentation needed, the required instrumentation calibration, the measurement procedure, and the calculations required for each procedure.

Standard Charge and Airflow Measurement Procedure

This section specifies the Standard charge and airflow measurement procedure. Under this procedure, required refrigerant charge is calculated using the Superheat Charging Method and adequate airflow across the evaporator coil is calculated using the Temperature Split Method.

The Standard procedure detailed in this section shall be completed when the outdoor temperature is 55°F or higher after the HVAC installer has installed and charged the system in accordance with the manufacturer's specifications. All HERS rater verifications are required to use this Standard procedure.

2.1 Minimum Qualifications for this Procedure

Persons carrying out this procedure need to be qualified to perform the following:

- Obtain accurate pressure/temperature readings from refrigeration manifold gauges.
- Obtain accurate temperature readings from thermometer and thermocouple set up.
- Check calibration of refrigerant gauges using a known reference pressure and thermometer/thermocouple set up using a known reference temperature.
- Determine best location for temperature measurements in ducting system and on refrigerant lineset.
- Calculate the measured superheat and temperature split.
- Determine the correct level of superheat and temperature split required, based on the conditions present at the time of the test.
- Determine if measured values are reasonable.

2.2 Instrumentation Specifications

Instrumentation for the procedures described in this section shall conform to the following specifications.

- 2.2.1 Digital Thermometer. Digital thermometer must have thermocouple compatibility (type K and J) and Celsius or Fahrenheit readout with:
  - Accuracy: ±(0.1% of reading + 1.3º F)
  - Resolution: 0.2º F to 1.0º F
- 2.2.2 Thermocouples. Measurements require five (5) heavy duty beaded low-mass wire thermocouples and one (1) cotton wick for measuring web-bulb temperatures.
- 2.2.3 Refrigerant Manifold Gauge Set. A standard multiport refrigerant manifold gauge set is required.

2.3 Calibration

The accuracy of instrumentation shall be maintained using the following procedures. A sticker with the calibration check date shall be affixed to each instrument calibrated.

2.3.1 Thermometer / Thermocouple Field Calibration Procedure

Thermometers/thermocouples shall be calibrated monthly to ensure that they are reading accurate temperatures. The following procedure shall be used to check thermometer/thermocouple calibration.

Step 1. Fill an insulated cup (foam) with crushed ice. The ice shall completely fill the cup. Add water to fill the cup.

Step 2. Insert two thermocouples into the center of the ice bath and attach them to the digital thermometer.

Step 3. Let the temperatures stabilize. The temperatures shall be 32°F (+/- 1°F). If the temperature is off by more than 1°F make corrections according to the manufacturer's instructions. Any thermocouples that are off by more than 3°F shall be replaced.

Step 4. Switch the thermocouples and ensure that the temperatures read on T1 and T2 are still within +/- 1°F of 32°F.

Step 5. Affix sticker with calibration check date onto thermocouple.

Step 6. Repeat the process for all thermocouples.

2.3.2 Refrigerant Gauge Field Check Procedure

Refrigerant gauges shall be checked monthly to ensure that the gauges are reading the correct pressures and corresponding temperatures. The following procedure shall be used to check gauge calibration.

Step 1. Place a refrigerant cylinder in a stable environment and let it sit for 4 hours minimum to stabilize to the ambient conditions.

Step 2. Attach a thermocouple to the refrigerant cylinder using duct tape so that there is good contact between the cylinder and the thermocouple.

Step 3. Insulate the thermocouple connection to the cylinder (closed cell pipe insulation can be taped over the end of the thermocouple to provide the insulation).

Step 4. Zero the low side compound gauge with all ports open to atmospheric pressure (no hoses attached).

Step 5. Re-install the hose and attach the low side gauge to the refrigerant cylinder.

Step 6. Read the temperature of the thermocouple.

Step 7. Using a pressure/temperature chart for the refrigerant, look up the pressure that corresponds to the temperature measured.

Step 8. If gauge does not read the correct pressure corresponding to the temperature, the gauge is out of calibration and needs to be replaced or returned to the manufacturer for calibration.

Step 9. Repeat the process in steps 4 through 8 for the high side gauge.

Step 10. Affix sticker with calibration check date onto refrigerant gauge.

2.4 Charge and Airflow Measurements

The following procedure shall be used to obtain measurements necessary to adjust refrigerant charge and airflow in the following sections.

Step 1. Turn system on and let it run for 15 minutes to stabilize temperatures and pressures before taking any measurements. While system is stabilizing, proceed with setting up the temperature measurements.

Step 2. Connect the refrigerant gauge manifold to the suction line service valve.

Step 3. Attach a thermocouple to the suction line near the suction line service valve. Be sure the sensor is in direct contact with the line and is well insulated from air temperature.

Step 4. Attach a thermocouple to measure the condenser (entering) air dry-bulb temperature. The sensor shall be shaded from direct sun.

Step 5. Be sure that all cabinet panels that affect airflow are in place before making measurements. The thermocouple sensors shall remain attached to the system until the final charge is determined.

Step 6. Place wet-bulb thermocouple in water to ensure it is saturated when needed. Do not get the dry-bulb thermocouples wet.

Step 7. Insert the dry-bulb thermocouple in the supply plenum at the center of the airflow.

Step 8. At 12 minutes, insert a dry-bulb thermocouple and a wet-bulb thermocouple into the return plenum at the center of the airflow.

Step 9. At 15 minutes when the return plenum temperatures have stabilized, using the thermocouples already in place, measure and record the return (evaporator entering) air dry-bulb temperature (Treturn, db) and the return (evaporator entering) air wet-bulb temperature (Treturn, wb).

Step 10. Using the dry-bulb thermocouple already in place, measure and record the supply (evaporator leaving) air dry-bulb temperature (Tsupply, db).

Step 11. Using the refrigerant gauge already attached, measure and record the evaporator saturation temperature (Tevaporator, sat) from the low side gauge.

Step 12. Using the dry-bulb thermocouple already in place, measure and record the suction line temperature (Tsuction, db).

Step 13. Using the dry-bulb thermocouple already in place, measure and record the condenser (entering) air dry-bulb temperature (Tcondenser, db).

The above measurements shall be used to adjust refrigerant charge and airflow as described in following sections.

2.5 Refrigerant Charge Calculations

The Superheat Charging Method is used only for non-TXV systems equipped with fixed metering devices. These include capillary tubes and piston-type metering devices. The following steps describe the calculations to determine if the system meets the required refrigerant charge using the measurements described in section 2.4. If a system fails, then remedial actions must be taken. Both the airflow and charge must be retested until they both pass

Step 1. Calculate Actual Superheat as the suction line temperature minus the evaporator saturation temperature. Actual Superheat = Tsuction, db – Tevaporator, sat.

Step 2. Determine the Target Superheat using Table L-1 using the return air wet-bulb temperature (Treturn, wb) and condenser air dry-bulb temperature (Tcondenser, db).

Step 3. If a dash mark is read from Table L-1, the target superheat is less than 5°F, then the system does not pass the required refrigerant charge criteria, usually because outdoor conditions are too hot and dry. One of the following adjustments is needed until a target superheat value can be obtained from Table L-1by either 1) turning on the space heating system and/or opening the windows to warm up indoor temperature; or 2) retest at another time when conditions are different. After adjustments, repeat the measurement procedure as often as necessary to establish the target superheat. Allow system to stabilize for 15 minutes before completing the measurement procedure again.

Step 4. Calculate the difference between actual superheat and target superheat (Actual Superheat - Target Superheat)

Step 5. If the difference is between minus 5 and plus 5°F, then the system passes the required refrigerant charge criteria.

Step 6. If the difference is greater than plus 5°F, then the system does not pass the required refrigerant charge criteria and the installer shall add refrigerant. After the refrigerant has been added, turn the system on and allow it to stabilize for 15 minutes before completing the measurement procedure again. Adjust refrigerant charge and repeat the measurement procedure as many times as necessary pass the test.

Step 7. If the difference is between –5 and -100°F and, then the system does not pass the required refrigerant charge criteria and the installer shall remove refrigerant. After the refrigerant has been removed, turn the system on and allow it to stabilize for 15 minutes before completing the measurement procedure again. Adjust refrigerant charge and repeat the measurement procedure as many times as necessary pass the test.

2.6 Adequate Airflow Calculations

The temperature split method is designed to provide an efficient check to see if airflow is above the required minimum. The following steps describe the calculations using the measurement procedure described in section2.4. If a system fails, then remedial actions must be taken. Both the airflow and charge must be retested until they both pass

Step 1. Calculate the Actual Temperature Split as the return air dry-bulb temperature minus the supply air dry-bulb temperature. Actual Temperature Split = Treturn, db - Tsupply, db

Step 2. Determine the Target Temperature Split from Table L-2 using the return air wet-bulb temperature (Treturn, wb) and return air dry-bulb temperature (Treturn, db).

Step 3. Calculate the difference between target and actual temperature split (Actual Temperature Split-Target Temperature Split). If the difference is within plus 3°F and minus 3°F, then the system passes the adequate airflow criteria.

Step 4. If the difference is greater than plus 3°F, then the system does not pass the adequate airflow criteria and the airflow shall be increased by the installer. Increasing airflow can be accomplished by eliminating restrictions in the duct system, increasing blower speed, cleaning filters, or opening registers. After corrective measures are taken, repeat measurement procedure as often as necessary to establish adequate airflow range. Allow system to stabilize for 15 minutes before repeating measurement procedure.

Step 5. If the difference is between minus 3°F and minus 25°F, then the measurement procedure shall be repeated making sure that temperatures are measured at the center of the airflow.

Step 6. If the re-measured difference is between plus 3°F and minus 3°F the system passes the adequate airflow criteria. If the re-measured difference is between minus 3°F and minus 25°F, the system passes, but it is likely that the capacity is low on this system (it is possible, but unlikely, that airflow is higher than average).

Alternate Charge and Airflow Measurement Procedure

This section specifies the Alternate charge and airflow measurement procedure. Under this procedure, the required refrigerant charge is calculated using the Weigh-In Charging Method and adequate airflow across the evaporator coil is calculated using the Measured Airflow Method.

HVAC installers who must complete system installation verification when the outdoor temperature is below 55°F shall use this Alternate procedure after installing and charging the system in accordance with the manufacturer's specifications.. HERS Raters shall not use this procedure to verify compliance.

Split system air conditioners come from the factory already charged with the standard charge indicated on the name plate. The manufacturer supplies the charge proper for the application based on their standard liquid line length. It is the responsibility of the HVAC installer to ensure that the charge is correct for each air conditioner and to adjust the charge based on liquid line length different from the manufacturer's standard.

3.1 Minimum Qualifications for this Procedure

HVAC installation technicians need to be qualified to perform the following:

- Transfer and recovery of refrigerant (including a valid Environmental Protection Agency (EPA) certification for transition and recovery of refrigerant).
- Accurately weigh the amount of refrigerant added or removed using an electronic scale.
- Calculate the refrigerant charge adjustment needed to compensate for non-standard lineset lengths/diameters based on the actual lineset length/diameter and the manufacturers specifications for adjusting refrigerant charge for non-standard lineset lengths/diameters.

3.2 Instrumentation Specifications

Instrumentation for the procedures described in this section shall conform to the following specifications.

3.2.1 Digital Charging Scale. The digital scale used to weigh in refrigerant must have a range of .5 oz to at least 1200 oz (75 lb.). The scales accuracy must be ± .25 oz.

3.3 Weigh-In Method

The following procedure shall be used by the HVAC installer to charge the system with the correct refrigerant charge.

Step 1. Obtain manufacturer's standard liquid line length and charge adjustment for alternate liquid line lengths.

Step 2. Measure and record the actual liquid line length (L actual).

Step 3. Record the manufacturer's standard liquid line length (L standard).

Step 4. Calculate the difference between actual and standard liquid line lengths (L actual - L standard).

Step 5. Record the manufacturer's adjustment for liquid line length difference per foot (A length).

Step 6. Calculate the amount of refrigerant to add or remove and document the calculations on the CF-6R.

Step 7. Weigh in or remove the correct amount of refrigerant

3.4 Airflow Measurement

The airflow across the indoor evaporator coil shall be measured using one of the 2 methods described Appendix J - Standard Procedure for Determining the Seasonal Energy Efficiencies of Residential Air Distribution Systems (Appendix F of the Residential ACM Approval Manual):

- Section 4.3.7.2.1 Diagnostic Fan Flow Using Flow Hood
- Section 4.3.7.2.2 Diagnostic Fan Flow Using Plenum Pressure Matching

3.5 Adequate Airflow Calculation

The measured airflow method is used to provide a check to see if airflow is above the required minimum of 385 CFM per nominal ton of capacity (assumes coil is dry). The following steps describe the calculations using the measurement procedure described in Section 3.4. If a system fails, then remedial actions must be taken. The airflow must be retested until it passes.

Step 1. Record the measured air flow (F measured) obtained from the measurement procedures described in Section 3.4.

Step 2. Obtain and record the rated cooling capacity (C cooling) in Btu.

Step 3. Calculate the required airflow as the product of the rated cooling capacity in Btu times 0.032.

Step 4. Compare the airflow measured according to section 3.4 with the required airflow.

Step 5. If the measured airflow is greater than the required airflow, then the system passes the adequate airflow criteria..

Step 6. If the measured airflow is less than the required airflow, the system does not pass the adequate airflow criteria and the air flow shall be increased by the installer. Increasing airflow can be accomplished by eliminating restrictions in the duct system, increasing blower speed, cleaning filters, or opening registers. After corrective measures are taken, repeat measurement procedure.

Table L-1: Target Superheat (Suction Line Temperature - Evaporator Saturation Temperature)

Condenser Air Dry-Bulb Temperature (°F)	Return Air Wet-Bulb Temperature (°F) (T return, wb)																												
	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76
55	8.8	10.1	11.5	12.8	14.2	15.6	17.1	18.5	20.0	21.5	23.1	24.6	26.2	27.8	29.4	31.0	32.4	33.8	35.1	36.4	37.7	39.0	40.2	41.5	42.7	43.9	45.0
56	8.6	9.9	11.2	12.6	14.0	15.4	16.8	18.2	19.7	21.2	22.7	24.2	25.7	27.3	28.9	30.5	31.8	33.2	34.6	35.9	37.2	38.5	39.7	41.0	42.2	43.4	44.6
57	8.3	9.6	11.0	12.3	13.7	15.1	16.5	17.9	19.4	20.8	22.3	23.8	25.3	26.8	28.3	29.9	31.3	32.6	34.0	35.3	36.7	38.0	39.2	40.5	41.7	43.0	44.2
58	7.9	9.3	10.6	12.0	13.4	14.8	16.2	17.6	19.0	20.4	21.9	23.3	24.8	26.3	27.8	29.3	30.7	32.1	33.5	34.8	36.1	37.5	38.7	40.0	41.3	42.5	43.7
59	7.5	8.9	10.2	11.6	13.0	14.4	15.8	17.2	18.6	20.0	21.4	22.9	24.3	25.7	27.2	28.7	30.1	31.5	32.9	34.3	35.6	36.9	38.3	39.5	40.8	42.1	43.3
60	7.0	8.4	9.8	11.2	12.6	14.0	15.4	16.8	18.2	19.6	21.0	22.4	23.8	25.2	26.6	28.1	29.6	31.0	32.4	33.7	35.1	36.4	37.8	39.1	40.4	41.6	42.9
61	6.5	7.9	9.3	10.7	12.1	13.5	14.9	16.3	17.7	19.1	20.5	21.9	23.3	24.7	26.1	27.5	29.0	30.4	31.8	33.2	34.6	35.9	37.3	38.6	39.9	41.2	42.4
62	6.0	7.4	8.8	10.2	11.7	13.1	14.5	15.9	17.3	18.7	20.1	21.4	22.8	24.2	25.5	27.0	28.4	29.9	31.3	32.7	34.1	35.4	36.8	38.1	39.4	40.7	42.0
63	5.3	6.8	8.3	9.7	11.1	12.6	14.0	15.4	16.8	18.2	19.6	20.9	22.3	23.6	25.0	26.4	27.8	29.3	30.7	32.2	33.6	34.9	36.3	37.7	39.0	40.3	41.6
64	-	6.1	7.6	9.1	10.6	12.0	13.5	14.9	16.3	17.7	19.0	20.4	21.7	23.1	24.4	25.8	27.3	28.7	30.2	31.6	33.0	34.4	35.8	37.2	38.5	39.9	41.2
65	-	5.4	7.0	8.5	10.0	11.5	12.9	14.3	15.8	17.1	18.5	19.9	21.2	22.5	23.8	25.2	26.7	28.2	29.7	31.1	32.5	33.9	35.3	36.7	38.1	39.4	40.8
66	-		6.3	7.8	9.3	10.8	12.3	13.8	15.2	16.6	18.0	19.3	20.7	22.0	23.2	24.6	26.1	27.6	29.1	30.6	32.0	33.4	34.9	36.3	37.6	39.0	40.4
67	-	-	5.5	7.1	8.7	10.2	11.7	13.2	14.6	16.0	17.4	18.8	20.1	21.4	22.7	24.1	25.6	27.1	28.6	30.1	31.5	33.0	34.4	35.8	37.2	38.6	39.9
68	-	-	-	6.3	8.0	9.5	11.1	12.6	14.0	15.5	16.8	18.2	19.5	20.8	22.1	23.5	25.0	26.5	28.0	29.5	31.0	32.5	33.9	35.3	36.8	38.1	39.5
69	-	-	-	5.5	7.2	8.8	10.4	11.9	13.4	14.8	16.3	17.6	19.0	20.3	21.5	22.9	24.4	26.0	27.5	29.0	30.5	32.0	33.4	34.9	36.3	37.7	39.1
70	-	-	-	-	6.4	8.1	9.7	11.2	12.7	14.2	15.7	17.0	18.4	19.7	20.9	22.3	23.9	25.4	27.0	28.5	30.0	31.5	33.0	34.4	35.9	37.3	38.7
71	-	-	-	-	5.6	7.3	8.9	10.5	12.1	13.6	15.0	16.4	17.8	19.1	20.3	21.7	23.3	24.9	26.4	28.0	29.5	31.0	32.5	34.0	35.4	36.9	38.3
72	-	-	-	-	-	6.4	8.1	9.8	11.4	12.9	14.4	15.8	17.2	18.5	19.7	21.2	22.8	24.3	25.9	27.4	29.0	30.5	32.0	33.5	35.0	36.5	37.9
73	-	-	-	-	-	5.6	7.3	9.0	10.7	12.2	13.7	15.2	16.6	17.9	19.2	20.6	22.2	23.8	25.4	26.9	28.5	30.0	31.5	33.1	34.6	36.0	37.5
74	-	-	-	-	-	-	6.5	8.2	9.9	11.5	13.1	14.5	15.9	17.3	18.6	20.0	21.6	23.2	24.8	26.4	28.0	29.5	31.1	32.6	34.1	35.6	37.1
75	-	-	-	-	-	-	5.6	7.4	9.2	10.8	12.4	13.9	15.3	16.7	18.0	19.4	21.1	22.7	24.3	25.9	27.5	29.1	30.6	32.2	33.7	35.2	36.7
76	-	-	-	-	-	-	-	6.6	8.4	10.1	11.7	13.2	14.7	16.1	17.4	18.9	20.5	22.1	23.8	25.4	27.0	28.6	30.1	31.7	33.3	34.8	36.3
77	-	-	-	-	-	-	-	5.7	7.5	9.3	11.0	12.5	14.0	15.4	16.8	18.3	20.0	21.6	23.2	24.9	26.5	28.1	29.7	31.3	32.8	34.4	36.0
78	-	-	-	-	-	-	-	-	6.7	8.5	10.2	11.8	13.4	14.8	16.2	17.7	19.4	21.1	22.7	24.4	26.0	27.6	29.2	30.8	32.4	34.0	35.6
79	-	-	-	-	-	-	-	-	5.9	7.7	9.5	11.1	12.7	14.2	15.6	17.1	18.8	20.5	22.2	23.8	25.5	27.1	28.8	30.4	32.0	33.6	35.2
80	-	-	-	-	-	-	-	-	-	6.9	8.7	10.4	12.0	13.5	15.0	16.6	18.3	20.0	21.7	23.3	25.0	26.7	28.3	29.9	31.6	33.2	34.8
81	-	-	-	-	-	-	-	-	-	6.0	7.9	9.7	11.3	12.9	14.3	16.0	17.7	19.4	21.1	22.8	24.5	26.2	27.9	29.5	31.2	32.8	34.4
82	-	-	-	-	-	-	-	-	-	5.2	7.1	8.9	10.6	12.2	13.7	15.4	17.2	18.9	20.6	22.3	24.0	25.7	27.4	29.1	30.7	32.4	34.0
83	-	-	-	-	-	-	-	-	-	-	6.3	8.2	9.9	11.6	13.1	14.9	16.6	18.4	20.1	21.8	23.5	25.2	26.9	28.6	30.3	32.0	33.7
84	-	-	-	-	-	-	-	-	-	-	5.5	7.4	9.2	10.9	12.5	14.3	16.1	17.8	19.6	21.3	23.0	24.8	26.5	28.2	29.9	31.6	33.3
85	-	-	-	-	-	-	-	-	-	-	-	6.6	8.5	10.3	11.9	13.7	15.5	17.3	19.0	20.8	22.6	24.3	26.0	27.8	29.5	31.2	32.9
86	-	-	-	-	-	-	-	-	-	-	-	5.8	7.8	9.6	11.3	13.2	15.0	16.7	18.5	20.3	22.1	23.8	25.6	27.3	29.1	30.8	32.6
87	-	-	-	-	-	-	-	-	-	-	-	5.0	7.0	8.9	10.6	12.6	14.4	16.2	18.0	19.8	21.6	23.4	25.1	26.9	28.7	30.4	32.2
88	-	-	-	-	-	-	-	-	-	-	-	-	6.3	8.2	10.0	12.0	13.9	15.7	17.5	19.3	21.1	22.9	24.7	26.5	28.3	30.1	31.8
89	-	-	-	-	-	-	-	-	-	-	-	-	5.5	7.5	9.4	11.5	13.3	15.1	17.0	18.8	20.6	22.4	24.3	26.1	27.9	29.7	31.5
90	-	-	-	-	-	-	-	-	-	-	-	-	-	6.8	8.8	10.9	12.8	14.6	16.5	18.3	20.1	22.0	23.8	25.6	27.5	29.3	31.1
91	-	-	-	-	-	-	-	-	-	-	-	-	-	6.1	8.1	10.3	12.2	14.1	15.9	17.8	19.7	21.5	23.4	25.2	27.1	28.9	30.8
92	-	-	-	-	-	-	-	-	-	-	-	-	-	5.4	7.5	9.8	11.7	13.5	15.4	17.3	19.2	21.1	22.9	24.8	26.7	28.5	30.4
93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.8	9.2	11.1	13.0	14.9	T16.8	18.7	20.6	22.5	24.4	26.3	28.2	30.1
94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.2	8.7	10.6	12.5	14.4	16.3	18.2	20.2	22.1	24.0	25.9	27.8	29.7
95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.6	8.1	10.0	12.0	13.9	15.8	17.8	19.7	21.6	23.6	25.5	27.4	29.4

96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.5	9.5	11.4	13.4	15.3	17.3	19.2	21.2	23.2	25.1	27.1	29.0
97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.0	8.9	10.9	12.9	14.9	16.8	18.8	20.8	22.7	24.7	26.7	28.7
98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.4	8.4	10.4	12.4	14.4	16.4	18.3	20.3	22.3	24.3	26.3	28.3
99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.8	7.9	9.9	11.9	13.9	15.9	17.9	19.9	21.9	24.0	26.0	28.0
100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.3	7.3	9.3	11.4	13.4	15.4	17.5	19.5	21.5	23.6	25.6	27.7
101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.8	8.8	10.9	12.9	15.0	17.0	19.1	21.1	23.2	25.3	27.3
102	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.2	8.3	10.4	12.4	14.5	16.6	18.6	20.7	22.8	24.9	27.0
103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.7	7.8	9.9	11.9	14.0	16.1	18.2	20.3	22.4	24.5	26.7
104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.2	7.2	9.3	11.5	13.6	15.7	17.8	19.9	22.1	24.2	26.3
105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.7	8.8	11.0	13.1	15.2	17.4	19.5	21.7	23.8	26.0
106	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.2	8.3	10.5	12.6	14.8	17.0	19.1	21.3	23.5	25.7
107	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.7	7.9	10.0	12.2	14.4	16.6	18.7	21.0	23.2	25.4
108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.2	7.4	9.5	11.7	13.9	16.1	18.4	20.6	22.8	25.1
109	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.9	9.1	11.3	13.5	15.7	18.0	20.2	22.5	24.7
110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.4	8.6	10.8	13.1	15.3	17.6	19.9	22.1	24.4
111	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.9	8.1	10.4	12.6	14.9	17.2	19.5	21.8	24.1
112	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.4	7.6	9.9	12.2	14.5	16.8	19.1	21.5	23.8
113	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.2	9.5	11.8	14.1	16.4	18.8	21.1	23.5
114	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.7	9.0	11.4	13.7	16.1	18.4	20.8	23.2
115	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.2	8.6	10.9	13.3	15.7	18.1	20.5	22.9

Table L-2: Target Temperature Split (Return Dry-Bulb – Supply Dry-Bulb)

Return Air Dry–Bulb (°F) ($T_{return, db}$)	Return Air Wet-Bulb (°F) ($T_{return, wb}$)																												
	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76
70	20.9	20.7	20.6	20.4	20.1	19.9	19.5	19.1	18.7	18.2	17.7	17.2	16.5	15.9	15.2	14.4	13.7	12.8	11.9	11.0	10.0	9.0	7.9	6.8	5.7	4.5	3.2
71	21.4	21.3	21.1	20.9	20.7	20.4	20.1	19.7	19.3	18.8	18.3	17.7	17.1	16.4	15.7	15.0	14.2	13.4	12.5	11.5	10.6	9.5	8.5	7.4	6.2	5.0	3.8
72	21.9	21.8	21.7	21.5	21.2	20.9	20.6	20.2	19.8	19.3	18.8	18.2	17.6	17.0	16.3	15.5	14.7	13.9	13.0	12.1	11.1	10.1	9.0	7.9	6.8	5.6	4.3
73	22.5	22.4	22.2	22.0	21.8	21.5	21.2	20.8	20.3	19.9	19.4	18.8	18.2	17.5	16.8	16.1	15.3	14.4	13.6	12.6	11.7	10.6	9.6	8.5	7.3	6.1	4.8
74	23.0	22.9	22.8	22.6	22.3	22.0	21.7	21.3	20.9	20.4	19.9	19.3	18.7	18.1	17.4	16.6	15.8	15.0	14.1	13.2	12.2	11.2	10.1	9.0	7.8	6.6	5.4
75	23.6	23.5	23.3	23.1	22.9	22.6	22.2	21.9	21.4	21.0	20.4	19.9	19.3	18.6	17.9	17.2	16.4	15.5	14.7	13.7	12.7	11.7	10.7	9.5	8.4	7.2	5.9
76	24.1	24.0	23.9	23.7	23.4	23.1	22.8	22.4	22.0	21.5	21.0	20.4	19.8	19.2	18.5	17.7	16.9	16.1	15.2	14.3	13.3	12.3	11.2	10.1	8.9	7.7	6.5
77	-	24.6	24.4	24.2	24.0	23.7	23.3	22.9	22.5	22.0	21.5	21.0	20.4	19.7	19.0	18.3	17.5	16.6	15.7	14.8	13.8	12.8	11.7	10.6	9.5	8.3	7.0
78	-	-	-	24.7	24.5	24.2	23.9	23.5	23.1	22.6	22.1	21.5	20.9	20.2	19.5	18.8	18.0	17.2	16.3	15.4	14.4	13.4	12.3	11.2	10.0	8.8	7.6
79	-	-	-	-	-	24.8	24.4	24.0	23.6	23.1	22.6	22.1	21.4	20.8	20.1	19.3	18.5	17.7	16.8	15.9	14.9	13.9	12.8	11.7	10.6	9.4	8.1
80	-	-	-	-	-	-	25.0	24.6	24.2	23.7	23.2	22.6	22.0	21.3	20.6	19.9	19.1	18.3	17.4	16.4	15.5	14.4	13.4	12.3	11.1	9.9	8.7
81	-	-	-	-	-	-	-	25.1	24.7	24.2	23.7	23.1	22.5	21.9	21.2	20.4	19.6	18.8	17.9	17.0	16.0	15.0	13.9	12.8	11.7	10.4	9.2
82	-	-	-	-	-	-	-	-	25.2	24.8	24.2	23.7	23.1	22.4	21.7	21.0	20.2	19.3	18.5	17.5	16.6	15.5	14.5	13.4	12.2	11.0	9.7
83	-	-	-	-	-	-	-	-	-	25.3	24.8	24.2	23.6	23.0	22.3	21.5	20.7	19.9	19.0	18.1	17.1	16.1	15.0	13.9	12.7	11.5	10.3
84	-	-	-	-	-	-	-	-	-	25.9	25.3	24.8	24.2	23.5	22.8	22.1	21.3	20.4	19.5	18.6	17.6	16.6	15.6	14.4	13.3	12.1	10.8