BSR/ASHRAE Standard 133-2015R

Public Review Draft

Method of Testing Direct Evaporative Air Coolers

First Public Review (November 2023)
(Draft Shows Proposed Independent Substantive Changes to Previous Public Review Draft)

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ASHRAE, 180 Technology Parkway NW, Peachtree Corners GA  30092
Standard 133-2015R
2nd Independent Substantive Change (ISC) Public Review Draft
Method of Testing Direct Evaporative Air Coolers

Note: In this document, changes to the first 133-2015R Publication Public Review Draft are indicated in the text by underlining (for additions) and strikethrough (for deletions).

3 DEFINITIONS AND ACRONYMS

appurtenance device electric input power: the electric input power to drive accessories — not including fans, pumps, or rotary devices — that are supplied as a standard component of the production model of the direct evaporative air cooler (DEC). Appurtenance device electric input power includes water metering devices, conductivity controllers, timers, dump cycle pumps, solenoids, and transformers providing low voltage to control mechanisms and freeze protection devices.

fan electric input power: the electric input power required to drive the fan and any drive train elements that are part of the fan.

pump or rotary device electric input power: the electric input power to drive the pump or rotary device used to distribute water in the DEC.

4 SYMBOLS AND SUBSCRIPTS

4.1 Symbols

\[ W_E \] total of all the electric input power for devices completely within the air upstream of the media section except the fan, W (W)

\[ W_L \] total of all the electric input power for devices completely within the air downstream of the media section except the fan, W (W)

\[ WF_E \] electric input power for fan if completely within the air upstream of the media section, W (W)

\[ WF_L \] electric input power for fan if completely within the air downstream of the media section, W (W)

\[ W_{\text{ex}} \] total of all the electric input power for devices outside and thermally isolated from the airstream of the DEC, W (W)

\[ W_{\text{total}} \] total DEC electric input power, W (W)
Revise Section 5 as shown below.

5. REQUIREMENTS

[...]

TABLE 1: Stability Criteria for Data Recording for Packaged DECs

<table>
<thead>
<tr>
<th>Measurement or Calculation Result</th>
<th>Values Calculated from Data Samples</th>
<th>Stability Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling capacity</td>
<td>$\bar{q}$, $\sigma_q$</td>
<td>$S_{\bar{q},std} \leq 0.05$</td>
</tr>
<tr>
<td>Total Electric Input Power</td>
<td>$W_{\text{total}}$, $\sigma_{W_{\text{total}}}$</td>
<td>$S_{W_{\text{total}}} \leq 0.05$</td>
</tr>
</tbody>
</table>

[...]

Revise Section 8 as shown below.

8. TEST DATA TO BE RECORDED

[...]

8.3 Test Data. Test data for each determination shall be recorded at each point of operation that satisfies the stability criteria. Readings shall be made simultaneously.

a. DEC inlet dry-bulb temperature $t_{d0}$, °C (°F)
b. DEC inlet wet-bulb temperature $t_{w0}$, °C (°F)
c. Ambient barometric pressure $p_b$, Pa (in. Hg)
d. DEC downstream dry-bulb temperature $t_{d2}$, °C (°F)
e. DEC downstream wet-bulb temperature $t_{w2}$, °C (°F)
f. Average fan speed for each fan $N$, rad/s (rpm)
g. The following electric input powers, power inputs, if applicable: $W_F, W_L, W_{ex}, W_E, W_L$ W (W)
h. Static pressure $p_{\text{std}}$, Pa (in. of water)
i. Static pressure $p_{\text{std}}$, Pa (in. of water)
j. Nozzle inlet airflow density $\rho$, kg/m³ (lbm/ft³)
k. All information required by ASHRAE Standard 41.2 to calculate the DEC volumetric airflow rate $Q$, m³/s (cfm) and the standard volumetric airflow rate $Q_{\text{std}}$, m³/s (scfm)
l. Water conductivity, (µS)
m. If a component DEC is not supplied with a pump or rotary device, record water flow to the DEC $Q_w$, m³/s (ft³/s)
n. The names of test personnel shall be listed.

Revise Section 9 as shown below.

9. CALCULATIONS

[...]

9.3 DEC Electric Input Power Input at Test Conditions.
The total electric input power input to the test unit is the sum of fan and pump or rotary device power and appurtenance device power.

$$W_{\text{total}} = W_F + W_L + W_{ex} + W_E + W_L \quad \text{W (W)}$$

SI/IP (9-1)

[...]

9.11 Fan Electric Input Power at Standard Conditions
Calculate the fan electric input power at standard conditions using Equation 9-25.
9.12 Total Fan Electric Input Power at Standard Conditions

Use Equation 9-26 to calculate the total fan electric input power at standard conditions.

\[
W_{\text{std}} = (W_E + WF_L)_{\text{std}} + W_{ex} + W_E + W_L \quad \text{SI/IP} \tag{9-26}
\]

Revise Section 10 as shown below.

10 TEST REPORT

10.2 Performance Curves. The following DEC test results shall be presented as performance curves:

- DEC standard volumetric airflow rate, \(Q_{\text{std}}\), SI or IP
- DEC standard total electric input power, \(W_{\text{std}}\), SI or IP
- DEC standard static pressure differential, \(\Delta P_{\text{std}}\), SI or IP
- DEC media saturation effectiveness, \(\varepsilon\), dimensionless
- DEC standard sensible cooling capacity, \(q_{\text{std}}\), SI or IP
- DEC overall performance, COP dimensionless (EER, Btu/(W-h))