BSR/ASHRAE Addendum g
to ANSI/ASHRAE Standard 90.4-2016

Public Review Draft

Proposed Addendum g to Standard 90.4-2016, *Energy Standard for Data Centers*

First Public Review (March 2019)
(Draft Shows Proposed Changes to Current Standard)

This draft has been recommended for public review by the responsible project committee. To submit a comment on this proposed standard, go to the ASHRAE website at www.ashrae.org/standards-research--technology/public-review-drafts and access the online comment database. The draft is subject to modification until it is approved for publication by the Board of Directors and ANSI. Until this time, the current edition of the standard (as modified by any published addenda on the ASHRAE website) remains in effect. The current edition of any standard may be purchased from the ASHRAE Online Store at www.ashrae.org/bookstore or by calling 404-636-8400 or 1-800-727-4723 (for orders in the U.S. or Canada).

This standard is under continuous maintenance. To propose a change to the current standard, use the change submittal form available on the ASHRAE website, www.ashrae.org.

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(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

The MLC values in 90.4-2016 are unnecessarily high. They were intended by the committee only as non-controversial interim values in order to quickly facilitate the first publication of 90.4. The committee's intention was to revisit and strengthen the MLC after the first publication. It turns out that the MLC values are less efficient than the data center efficiency requirements in 90.1-2010 and far less efficient than the data center requirements in other energy standards such as the energy codes in California, Oregon and Washington. One of the controversial issues that the committee did not want to tackle was the use of air economizers for data centers. In order to improve the MLC while still avoiding the issue of air economizers, the committee has calculated new MLCs that can easily be achieved using many readily available packaged cooling products including (a) packaged computer room air conditioners with indirect evaporative cooling (IEC) and (b) packaged air-cooled chillers with integrated dry-coolers serving packaged computer room air handlers without airside economizers. Packaged IEC units are readily available from most of the leading computer room air conditioner manufacturers. An IEC unit uses an air-to-air heat exchanger to cool return air from the data center by spraying water on the outside of the heat exchanger and drawing outside air (scavenger air) across the outside of the heat exchanger. The outside air does not mix with the recirculated data center air. No outside air or humidity is introduced into the data center, which eliminates any air quality or humidity control issues associated with an airside economizer. A DX coil handles any load that cannot be handled by the indirect evaporative air cooler. Packaged air-cooled chillers with integrated dry-cooler coils are also readily available from multiple manufacturers.

The MLCs proposed herein are still conservative. They can easily be achieved by one or both of the non-air economizer systems described above. Considerably lower MLCs can be achieved using airside economizers, while still adhering to the ASHRAE TC 9.9 Recommended Thermal Guidelines.

Design MLC was also an interim step that is not a good indicator of actual energy efficiency or actual annual energy use. There are now readily available tools and techniques for calculating Annualized MLC. Therefore, Design MLC is removed as a compliance option.

[Note to Reviewers: This addendum makes proposed changes to the current standard. These changes are indicated in the text by <u>underlining</u> (for additions) and ~~strikethrough~~ (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Only these changes to the current standard are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed changes.]

Addendum g to 90.4-2016

Modify Section 3.2 as follows:

~~***design mechanical load component (design MLC):*** the sum of all cooling, fan, pump, and heat rejection design power divided by the *data center ITE design power.*~~

Modify Section 4.2.2.2 as follows:

If compliance is to be shown for mechanical *systems* only, the designer performs the calculations in Sections ~~6.2.1.1 or~~ 6.2.1.2.

Delete Section 6.2.1.1 and Table 6.2.1.1.

Modify Section 6.2.1.2 as follows:

6.2.1.2 **Maximum** *Annualized Mechanical Load Component*. *Annualized MLC* shall be calculated using Equation 6.2.1.2. The resulting value shall be less than or equal to the value in Table 6.2.1.2, "Maximum *Annualized Mechanical Load Component*," ~~when evaluated at 100% *ITE* load for the appropriate climate zone. The calculated MLC shall also be less than or equal to the corresponding Table 6.2.1.2 MLC value when evaluated at 50% of design *ITE* load~~.

…When evaluating the cooling design energy at ~~50%~~ part load, any change in *UPS* or transformer *efficiency* at that reduced load must be included in the ~~50%~~ part load cooling design energy….

… The systems' energy calculation may consider operation of economizer capacity in the design and available redundant equipment at the 100% ITE load condition and separately at the ~~50%~~ ITE part load conditions if calculated using partially loaded equipment efficiencies.

… The *data center energy* calculations shall be completed separately for 100% and for ~~50% of design~~ part load *ITE* capacity in the calculations. The *system's UPS* and transformer cooling loads must also be included in this term, evaluated at their corresponding part-load efficiencies.

Replace Equation 6.2.1.2 with the following:

Annualized MLC = (Mech-Energy25% + Mech-Energy50% + Mech-Energy75% + Mech-Energy100%) / (Data Center ITE Energy25% + Data Center ITE Energy50% + Data Center ITE Energy75% + Data Center ITE Energy100%)
where
Mech-EnergyX% = total annual Cooling Energy + Pump Energy + Heat Rejection Fan Energy + Air Handler Fan Energy at a constant ITE load of X% of the design ITE load. This requires calculating annual energy use at each of the following ITE loads: 25%, 50%, 75%, 100%.
Data Center ITE EnergyX% = design ITE load * 8760* X% (e.g. Data Center ITE Energy50% for a design ITE load of 1,000 kW = 1,000 kW * 8760 hrs * 0.5 = 4,380,000 kWhrs)

Modify Table 6.2.1.2 as follows:

TABLE 6.2.1.2 Maximum *Annualized Mechanical Load Component (Annualized MLC)*

Climate Zones as Listed in ASHRAE Standard 169	**HVAC Maximum *Annualized MLC* ~~at 100% and at 50% *ITE* Load~~ for *data center ITE design power* > 300 kW**	**HVAC Maximum *Annualized MLC* for *data center ITE design power* <= 300 kW**
0A	~~0.37~~ 0.25	0.31
0B	~~0.40~~ 0.28	0.34
1A	~~0.36~~ 0.26	0.31
1B	~~0.38~~ 0.27	0.32
2A	~~0.35~~0.23	0.29
3A	~~0.33~~0.21	0.27
4A	~~0.33~~ 0.18	0.26
5A	~~0.33~~ 0.16	0.25
6A	~~0.32~~ 0.16	0.24
2B	~~0.36~~ 0.17	0.27
3B	~~0.35~~ 0.17	0.26

4B	~~0.35~~ 0.14	0.24
5B	~~0.33~~ 0.14	0.23
6B	~~0.34~~ 0.14	0.24
3C	~~0.32~~ 0.14	0.23
4C	~~0.32~~ 0.14	0.23
5C	~~0.32~~ 0.14	0.23
7	~~0.32~~ 0.14	0.23
8	~~0.32~~ 0.13	0.22

Revise Section 8.2.1.2 as follows:

8.2.1.2 **Maximum** *Design Electrical* **Loss Component** for Designs Involving Both Electrical and Mechanical *Systems*. *Design ELC* shall be calculated in accordance with Section 8.3 and shall be combined with the ~~Design~~ *Annualized MLC* in accordance with Section 11.

Revise Section 11 as follows:

11.1.1 **Sections 6 and 8 Trade-Off Method Scope.** The Sections 6 and 8 Trade-Off Method is an alternative to individually demonstrating compliance with Sections 6 and 8 requirements. It shall be allowed for demonstrating compliance when evaluating the proposed designs when either the ~~Design~~ *Annualized MLC* or *design ELC* is greater than the maximum allowed by the standard.

…

b. The sum of the calculated values of the ~~design~~ *Annualized MLC* value and the *design ELC* shall be equal to or less than the maximum overall *systems* design value. (The sum of the ~~design~~ *Annualized MLC* value and the *design ELC* value create an overall *Systems* design value.)

…

Examples

For a particular design in Climate Zone 1A with a single-feed *UPS* at 100% load, the maximum MLC = ~~0.460~~ 0.260 from Table ~~6.2.1.1~~ 6.2.1.2, and the maximum ELC = 0.297 from Table 8.2.1.1. Adding the two values together provides a maximum overall *systems* design value of ~~0.757~~ 0.557.

Max MLC Value [~~0.460~~ 0.260] + Max ELC Value [0.297] =
Maximum Overall *Systems* Value [~~0.757~~ 0.557]

If the electrical *system* design produces a *design ELC* of 0.328, which exceeds the maximum ELC value, a more efficient mechanical *system* can be used to offset this. If the mechanical *system* had a ~~design~~ annualized MCL of ~~0.390~~ 0.190 then the overall *systems* design value would be less than the maximum overall *systems* design value and would demonstrate compliance with the standard.

~~*Design*~~ *Annualized MLC* Value [~~0.390~~ 0.190] + *Design ELC* Value [0.327] = Overall *Systems* Design Value [~~0.717~~ 0.517]