California Title 24 - 2013
The new requirements and what they mean for your data center

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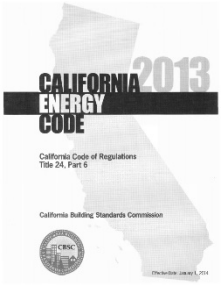


The latest 2013 revision of the California Energy Code (Title 24 of the CA Code of Regulations, Part 6) contains implications for the way we cool data centers, server rooms, MDF's, IDF's, and just about every other computer room in California going forward. These new regulations have produced a significant amount of speculation, confusion, and misinformation in the marketplace as it applies to data center cooling. This has caused some California companies with dedicated IT space to question their ability to expand their data center space as needed.

There are many cost effective, high-efficiency, off-the-shelf, low PUE ways to comply with the new regulations in your expansion plans. The new requirements are not as onerous as some would suggest, and a little guidance can clear up a lot of uncertainties among IT planners tasked with navigating the law and keeping their IT equipment running optimally. Such consultation is where I spend the majority of my time these days, and it has become clear to me that some clarity would be welcomed by the IT community regarding Title 24. Hence, this article.

The new Title 24 regulations have produced a significant amount of speculation, confusion, and misinformation in the marketplace as it applies to data center cooling. This has caused some California companies with dedicated IT space to question their ability to expand their data center space as needed. This trepidation is unwarranted. The over-arching theme of the new Title 24 rules is efficiency improvement. They represent a *best-practices framework* that reduces daily operating costs and carbon footprint associated with powering a data center. In many cases (not always) this requires increased capital expense on the front end, but this extra capital cost is more than compensated for by the reduction of operating costs over the life of the data center.

It what situations do the new rules apply?

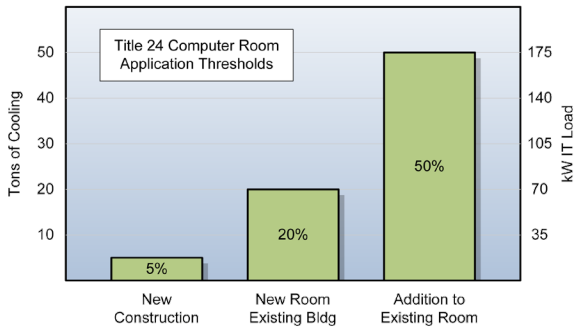
While the Title 24 building codes govern the design of buildings of all kinds, in this article we are discussing only the sections related to what code refers to as "Computer Rooms". Title 24 defines a computer room as:

> "*A room whose primary function is to house electronic equipment and that has a design equipment power density exceeding 20watts/ft² (215 watts/m²) of conditioned floor space*"

An IT rack typically occupies around 20 square feet in a room (accounting for clearance and infrastructure) which means any application with more than 400 watts/rack fits the definition of a Computer Room. So if you are wondering whether or not your IDF or server room qualifies as a computer room, it almost surely does.

It is possible that any concerns you may have about the new requirements are unfounded because you are "under the radar" with the size of your future plans. The Code only implements new requirements if the new data center space is above certain thresholds in terms of cooling capacity. These thresholds, above which compliance with the code is triggered, are defined as follows:

- *All **new construction** Computer Room loads over **5 tons** of cooling **(17.5 kW IT load)***
- *Any **new computer room in an existing building** that adds more than a total of **20 tons** of cooling **(70 kW IT load)** above 2013 baseline*
- *Any **addition to an existing room** that adds more than a total of **50 tons** of cooling **(175 kW IT load)** above 2013 baseline*



So for example, you would be able to add up to 175 kW of IT heat load to your existing data center over the coming years without being subject to the new 2013 Title 24 code requirements, but as soon as you exceed 175 kW IT heat load above what it was at the end of 2013 you become subject to the new regulations. Similarly, you would be able to build a new data center in an existing building with up to 70 kW if IT heat load without triggering compliance, or include a new server room in your new building up to 17.5 kW of IT heat load without compliance concerns.

What are the new CA Title 24 code requirements for data centers?

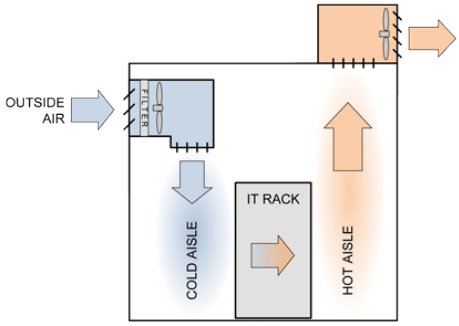
Economization

Most of the new requirements for data centers affect the way it is cooled. Legacy computer room air conditioners (CRAC units) involve the common refrigeration cycle, where refrigerant is compressed, cooled, expanded, and heated in a continuous loop. This method involves an electric motor-driven compressors, which draw a high amount of electricity compared with other more

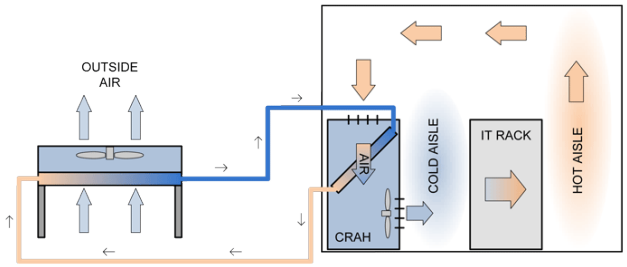
efficient options that are available today. In addition, the traditional CRAC approach requires high amounts of fan power in order to move enough air to remove the required amount of heat – a result of poor hot/cold air separation and management.

To correct these issues and reduce the amount of energy data centers use just to cool themselves, the new Title 24 rules require the use of cooling **economization**. Cooling economization is a set of cooling techniques whereby the cooling medium (either air or water) rejects heat directly to the outside environment, eliminating the use of motor-driven compressors and the traditional refrigeration cycle.

The two types of economization being employed in modern data centers are "*air- side*" and "*water-side*" economization. Sometimes referred to as "*free cooling*" these techniques are not actually free since there are still some components which require power, but the operating costs are far lower than legacy refrigeration-based techniques. Conceptually, these two types of economization are quite simple to understand.



Air-Side Economization at its simplest level involves using outside air to cool the data center. There are many ways to do this, with varying levels of complexity. Simply opening doors and windows would be a form of air-side economization (although not a particularly effective or secure one). The image at left shows a simple example of air-side economization. More complex approaches can utilize evaporative cooling, indirect air handling with air-to-air heat exchange, and many more.



Water-Side Economization is applied to systems which use water to transfer heat away from the data center. In its simplest form, cool water passes through the coil in the CRAH unit and picks up heat from the warm data center return air. This warmed water is sent to an outdoor cooler (dry cooler or cooling tower) where the heat is removed and the cooled water is sent back to the CRAH unit.

The new Title 24 code requires either air or water economization for computer rooms. The capabilities of these systems must be as follows:

> *Air-side Economized System* – must be capable of carrying 100% of the IT heat load when the outside air temperature is 55° F or lower.
>
> *Water-side Economized System* - must be capable of carrying 100% of the IT heat load when the outside air temperature is 40° F or lower.

More traditional refrigeration-cycle methods of cooling can still be used if the outside air temperature is above these thresholds, but the system must switch to economization when the outside air temperature drops below these levels. With modern cooling equipment options available today, *compliance with these requirements is not a major challenge*.

A significant aspect of the new economization requirements is this:

> *If you expand an existing data center beyond the compliance trigger threshold, all of the cooling in the data center must comply, not just the incremental addition.*

Reheat Prohibited

A traditionally common way to reduce humidity in a room is to run the evaporator coil in a refrigerant-based CRAC unit at a low enough temperature that water condenses out of the air and is pumped out of the room to a drain location. This frequently leaves the air at a lower than desired temperature, which is compensated for by "reheating" the supply air by any of several available methods just prior to entering the room. This practice is no longer permitted.

Humidification

Energy-intensive (non-adiabatic) methods of humidification are no longer allowed. These include steam and infrared methods. Only adiabatic methods are allowed, including ultra-sonic and direct-evaporation. The American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) relaxed some of the allowable humidity thresholds in 2011. Humidity can still be a concern, particularly with Air-Side Economization where outside air is introduced to the data center. Some helpful links :

> The Green Grid – White Paper #46 - Updated Air-Side Free Cooling Maps: The Impact of ASHRAE 2011 Allowable Ranges
>
> The Data Center Journal - Humidity in the Data Center: Do We Still Need to Sweat It?

Fan Efficiency

A minimum fan efficiency is now required for all computer room cooling systems. Fan power at design conditions of an individual cooling system must not exceed 27 W/kBtu/hr of net sensible cooling capacity of the system. Stated another way, and in more convenient units: it must not require more than 92 watts of fan power for the cooling system to remove 1000 watts of IT heat load.

Maximum Allowable Fan Power = 92 watts per kW of IT load

Fan Control

Variable speed fan control must be part of any cooling system with greater than 60 kBtu/hr capacity (17.5 kW of IT heat load). This control must vary the fan speed in proportion to the heat load and consume no more than 50% of design fan power at 66% of design fan speed. Any modern variable speed fan will easily meet this criteria. Universal fan laws predict a theoretical power reduction of over 70% when the fan speed is reduced by 34% (to 66% of full speed).

Air Containment

Isolation of the hot and cold air in a computer room is now required for rooms above 175 kW total design IT load. This can be achieved in any of a number of ways, as long as hot/cold air mixing is substantially prohibited. Exceptions to this containment requirement include: expansions of existing computer rooms, IT racks with a design load under 1 kW, equivalent energy performance based on engineering analysis.

Summary

The requirements for data center cooling techniques put in place by the new 2013 California Title 24 regulations require us to think a little differently, but they are not overly burdensome when the operational savings annuity is considered in the cost analysis. The key is smart design, utilizing modern cooling components in an efficiently engineered cooling infrastructure.

Questions? Contact the author:

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