

California Title 24, Pool Systems and Equipment Installation

45-Day Language Review & Revision Suggestions

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By Association of Pool and Spa Professionals (APSP) Technical Committee

Overview

The California Energy Commission is proposing new regulations for residential swimming pools. Proposed regulations impact systems included pumps, controls, filters, heaters, valves, pipe size, 90 degree elbow design, equipment pad size and system flow rates. This report is intended to highlight energy related swimming pool regulations and their effect on current design practices. It also suggests alternate language intended to meet California's energy conservation goals while reducing unintended consequences and eliminating requirements that do not achieve these goals.

- The review begins with *2008 Building Energy Efficiency Standards*, providing current and draft 45-day language. These sections are snap-shots from the CEC document. Revisions to current Title 24 regulations are indicated two ways, deleted text is indicated by ~~striketrough~~, new regulations are indicated by underlined text.
- The second area discusses the meaning and potential effects from the pool industry's point of view and provides suggested revisions.

2008 Building Energy Efficiency Standards - Residential Swimming Pools

CALIFORNIA CODE OF REGULATIONS, TITLE 24, PART 1

SECTION 10-101 – SCOPE

- (a) This article contains administrative regulations relating to the energy building regulations in Title 24, Part 6. This article applies to all residential and nonresidential buildings.
- (b) Nothing in this article lessens any necessary qualifications or responsibilities of licensed or registered building professionals or other designers or builders, or the duties of enforcement agencies that exist under state or local law.

NOTE: Authority cited: Sections 25402 and 25402.1, Public Resources Code. Reference: Sections 25402 and 25402.1, Public Resources Code.

SECTION 101 – DEFINITIONS AND RULES OF CONSTRUCTION

POOLS, ANSI/NSPI-5 is the American National Standards Institute and National Spa and Pool Institute document entitled “American National Standard for Residential Inground Swimming Pools” 2003 (ANSI/NSPI-5 2003).

POOLS, AUXILIARY POOL LOADS are features or devices that circulate pool water in addition to that required for pool filtration, including, but not limited to, solar pool heating systems, filter backwashing, pool cleaners, waterfalls, fountains, and spas.

POOLS, BACKWASH VALVE is a diverter valve designed to backwash filters located between the circulation pump and the filter, including, but not limited to, slide, push-pull, multi-port, and full-flow valves.

POOLS, MULTI-SPEED PUMP is a pump capable of operating at two (2) or more speeds and includes two-speed and variable-speed pumps.

POOLS, NSF/ANSI 50 is the NSF International (formerly National Sanitation Foundation) Standard and American National Standards Institute document entitled “Circulation System Components and Related Materials for Swimming Pools, Spas/Hot Tubs” 2005 (NSF/ANSI 50 – 2005).

POOLS, RESIDENTIAL are permanently installed residential in-ground swimming pools intended to use by a single-family home for noncommercial purposes and with dimensions as defined in ANSI/NSPI-5.

SPA is a vessel that contains heated water in which humans can immerse themselves, is not a pool, and is not a bathtub.

SYSTEM is a combination of equipment, controls, accessories, interconnecting means, or terminal elements by which energy is transformed to perform a specific function, such as space conditioning, service water heating, or lighting.

SECTION 110 – SYSTEMS AND EQUIPMENT – GENERAL

Sections 111 through 119 establish requirements for the manufacturing, construction, and installation of certain systems, equipment and building components that are installed in buildings regulated by Title 24, Part 6. Systems, equipment and building components listed below may be installed only if:

- (a) The manufacturer has certified that the system, equipment or building component complies with the applicable manufacturing provisions of Sections 111 through 119; and
- (b) The system, equipment or building component complies with the applicable installation provisions of Sections 111 through 119.

No system, equipment or building component covered by the provisions of Sections 111 through 119, that is not certified or that fails to comply with the applicable installation requirements, may be installed in a building regulated by Title 24, Part 6.

The systems, equipment and building components covered are:

Pool and spa heating systems and equipment (Section 114).

SECTION 111 – MANDATORY REQUIREMENTS FOR APPLIANCES REGULATED BY THE APPLIANCE EFFICIENCY REGULATIONS

Any appliance for which there is a California standard established in the Appliance Efficiency Regulations may be installed only if the manufacturer has certified to the ~~e~~ommissionCommission, as specified in those regulations, that the appliance complies with the applicable standard for that appliance. See Appendix 1-A for availability of directories of certified appliances.

SECTION 114 – MANDATORY REQUIREMENTS FOR POOL AND SPA HEATING SYSTEMS AND EQUIPMENT

(a) **Certification by Manufacturers.** Any pool or spa heating system or equipment may be installed only if the manufacturer has certified that the system or equipment has all of the following:

1. **Efficiency.** A thermal efficiency that complies with the Appliance Efficiency Regulations; and
2. **On-off switch.** A readily accessible on-off switch, mounted on the outside of the heater that allows shutting off the heater without adjusting the thermostat setting; and
3. **Instructions.** A permanent, easily readable, and weatherproof plate or card that gives instruction for the energy efficient operation of the pool or spa and for the proper care of pool or spa water when a cover is used; and
4. **Electric resistance heating.** No electric resistance heating; and

EXCEPTION 1 to Section 114(a)4: Listed package units with fully insulated enclosures, and with tight-fitting covers that are insulated to at least R-6.

EXCEPTION 2 to Section 114(a)4: Pools or spas deriving at least 60 percent of the annual heating energy from site solar energy or recovered energy.

5. **Pilot light.** No pilot light.

(b) **Installation.** Any pool or spa heating system or equipment shall be installed with all of the following:¹⁰

1. **Piping.** At least 36 inches of pipe shall be installed between the filter and the heater or built-in or built-up connections to allow for the future addition of solar heating equipment; and
2. **Covers.** A cover for outdoor pools or outdoor spas that have a heat pump or gas heater.

~~**EXCEPTION to Section 114 (b) 2:** Pools or spas deriving at least 60 percent of the annual heating energy from site solar energy or recovered energy.~~

3. **Directional inlets and time switches for pools.** If the system or equipment is for a pool:
 - i. The pool shall have directional inlets that adequately mix the pool water; and
 - ii. A time switch or similar control mechanism shall be installed as part of the pool water circulation control system that will allow all. The circulation pump shall have a time switch that allows the pumps to be set or programmed to run during the off-peak electric demand period, and for the minimum time necessary to maintain the water in the condition required by applicable public health standards.

~~**EXCEPTION to Section 114 (b) 3:** Where applicable public health standards require on-peak operation.~~

SECTION 115 – NATURAL GAS CENTRAL FURNACES, COOKING EQUIPMENT, AND POOL AND SPA HEATERS: PILOT LIGHTS PROHIBITED

Any natural gas system or equipment listed below may be installed only if it does not have a continuously burning pilot light:

- (c) Pool heaters.

SECTION 147 – REQUIREMENTS FOR OUTDOOR LIGHTING

This section applies to all outdoor lighting, whether attached to buildings, poles, structures or self supporting, including but not limited to, hardscape areas including parking lots, lighting for building entrances, sales and non-sales canopies; lighting for all outdoor sales areas; and lighting for building facades.

EXCEPTIONS to Section 147: When more than fifty percent of the light from a luminaire falls on one or more of the following applications, the lighting power for that luminaire shall be exempt from Section 147(b):

9. Lighting used in or around swimming pools, water features, or other locations subject to Article 680 of the California Electrical Code.

SECTION 150 – MANDATORY FEATURES AND DEVICES

(p) Pool Systems and Equipment Installation. Any residential pool system or equipment installed shall comply with the applicable requirements of Section 114 as well as the requirements listed in this Section.

1. Pump sizing and flow rate.

A. All pumps and pump motors installed shall be listed in the Commission’s directory of certified equipment and shall comply with the Appliance Efficiency Regulations.

B. All pump flow rates shall be calculated using the following system equation:

$$H = C X F^2$$

Where:

H is the total system head in feet of water.

F is the flow rate in gallons per minute (gpm).

C is a coefficient based on the volume of the pool:

0.0167 for pools less than or equal to 17,000 gallons.

0.0082 for pools greater than 17,000 gallons.

and:

C. Filtration pumps shall be sized, or if programmable, shall be programmed, so that the filtration flow rate is not greater than the rate needed to turn over the pool water volume in six hours or 36 gpm, whichever is greater; and

D. Pump motors used for filtration with a capacity of one horsepower or more shall be multi-speed; and

E. Each auxiliary pool load shall be served by either separate pumps or the system shall be served by a multi-speed pump; and

F. Multi-speed pumps shall have controls which default to the filtration flow rate when no auxiliary pool loads are operating; and

G. For multi-speed pumps, the controls shall default to the filtration flow rate setting within twenty four hours and shall have an override capability for servicing.

2. System piping.

A. A length of straight pipe that is greater than or equal to at least 4 pipe diameters shall be installed before the pump; and

B. Pool piping shall be sized so that the velocity of the water at maximum flow for auxiliary pool loads does not exceed eight feet per second in the return line and six feet per second in the suction line; and

C. All elbows shall be sweep elbows or elbow-type fittings with a friction factor less than or equal to an equivalent sweep elbow.

3. Filters. Filters shall be at least the size specified in NSF/ANSI 50 for public pool intended applications.

4. Valves. Minimum diameter of backwash valves shall be two inches or the diameter of the return pipe, whichever is greater.

Discussion - Potential Impact on the Pool and Spa Industry

Refer to the 45-Day Language above for purposes of this discussion.

Section 10-101-Scope:

This section provides the authority for the CEC to promulgate Title 24 Regulations.

Section 110 - DEFINITIONS AND RULES OF CONSTRUCTION

These definitions and rules are self evident, with the potential exception of “Pools, Residential”.

By defining pools according to dimensional definitions of ANSI/NSPI-5 *Standard for Residential Inground Swimming Pools*, all other bodies of water are excluded from Title 24 Regulations. For example Aboverground/Onground Residential Swimming Pools, Permanently Installed Residential Spa, and Residential Portable Spas (Hot Tubs) are excluded by this definition.

Whenever Title 24 references Residential Pools, everything else is excluded.

SECTION 110 – SYSTEMS AND EQUIPMENT – GENERAL

This section establishes that Residential Swimming Pools and Spas are included in the proposed Title 24 Regulations.

SECTION 111 – MANDATORY REQUIREMENTS FOR APPLIANCES REGULATED BY THE APPLIANCE EFFICIENCY REGULATIONS

This section establishes that Pool Heaters, Heat pumps, and Filtration Pool Pumps to be installed on new Residential Pools and Spas, must be on the CEC list of certified Appliances.

SECTION 114 – MANDATORY REQUIREMENTS FOR POOL AND SPA HEATING SYSTEMS AND EQUIPMENT

Much of this section is not new to California, with the notable exception of allowing fittings and/or valve for the future installation of solar. Current language requires 36” if pipe between the filter and the heater for future installation of solar.

Currently Section 114 only applies to pools equipped with heaters or heat pumps. The proposed new language would include all pools, even those without a heater or heat pump.

Change to this section introduce several new issues.

1. By removing “heating” from the Section 114 heading, this section is no longer consistent with other, section in Title 24 dealing with building heating equipment. This leads to confusion when attempting to understand the regulations. The apparent intent is to require all pools (with and without heaters or heat pumps) to have directional inlets and time clocks. However with these requirements buried under heater and heat pump regulations, they are easily overlooked.

Suggested revision. Restore “heating” to the title and the other locations within Section 114. Move section (b) “Installation.” to Section 150 “Mandatory features and devices.” This achieves the apparent goal of applying these requirements to all residential swimming pools.

2. By applying Section 114, (b) 1. “Piping” to all pools, as currently written, it could be concluded that heaters are required. To allow for the future addition of solar heating equipment, this regulation requires pipe or fittings between the filter and the “heater”. What if the buyer does not want a heater?

Suggested revision. Add “for pools that have a heat pump or gas heater.” This addition clarifies the intent whether this remains in Section 114, or is moved to Section 150.

SECTION 150 – MANDATORY FEATURES AND DEVICES, (p) Pool Systems...

This section is new to the pool industry, with the greatest impact coming from a limit on pump size for filtering pools and the requirement to use sweep 90s instead of standard 90s (sharp inside corner).

Section 150 (p) 1. regulates pump design (single-speed vs multi-speed) and total horsepower based on the size of the pool (gallons). The goal is to limit the energy consumed while effectively filtering the swimming pool. This is achieved by requiring small pumps or multi-speed pumps with flow rates that will not exceed the GPM needed to produce a public pool turnover rate, which is six hours. This can be difficult to understand based on a quick reading of the proposed regulations, however with a graphical representation (*Figure 1*) the methodology becomes more evident.

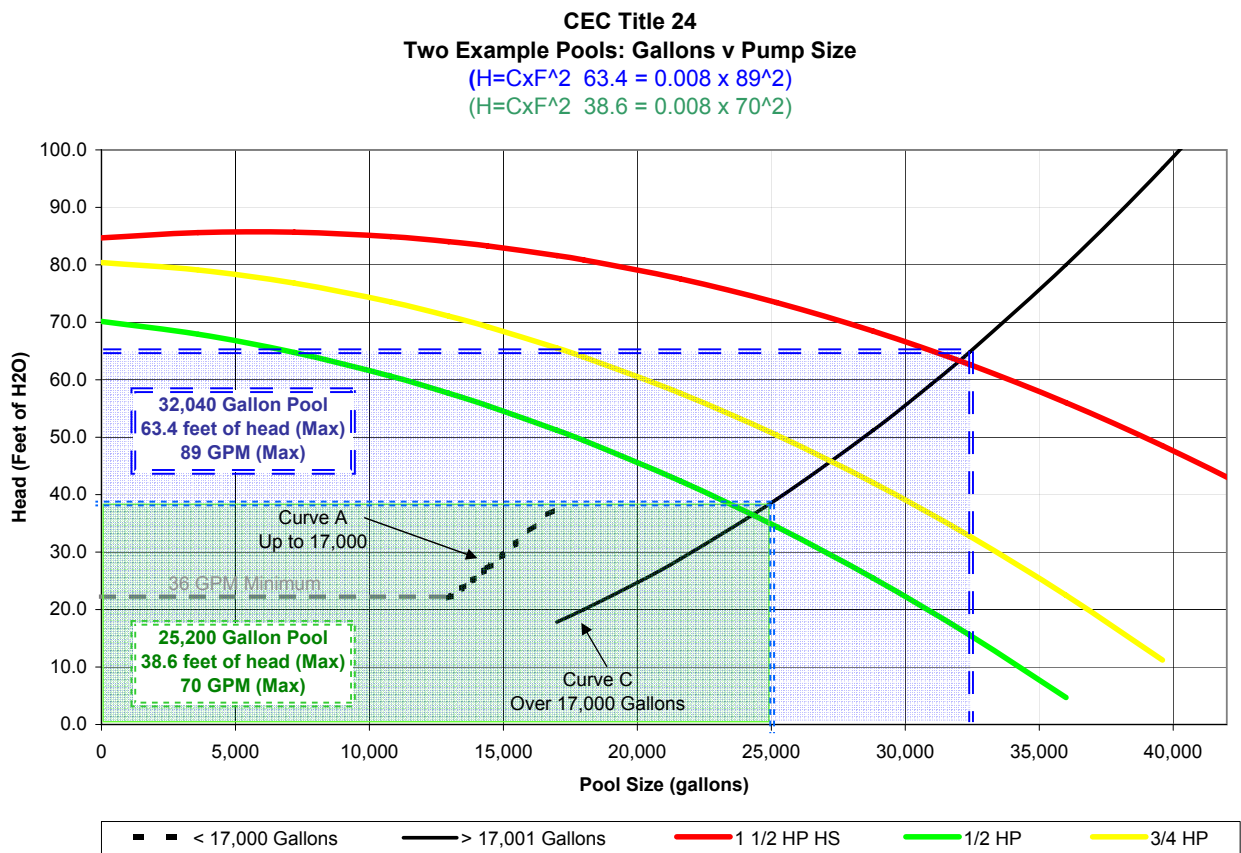


Figure 1

Two example pools are evaluated using the Title 24 formula. The first is a 32, 040 gallon pool. Using the formula the pump curve must cross Curve C below 63.4 feet of head and 89 GPM. All three pumps in this example are acceptable for use on this pool. The second example is a 25, 200 gallon pool. The formula says the pump curve must cross Curve C below 38.6 feet of head and 70 GPM. Only the 1/2 HP pump crosses Curve C below the formula point, the other example pumps are too large.

An important point is Title 24 does not limit head once the pump is installed, only GPM is limited by the six-hour turnover minimum, or 36 GPM, whichever is greater.

The following “pump sizing and flow rate” elements are combined to achieve the energy reduction goals:

- The pump must be on the CEC’s certified list. [ref. (p) 1. A.]
- The size of the pool (gallons) determines which one of two system curves is to be used. (coefficients based on the volume of the pool. $C = 0.008$ over 17, 000 gallons; $C = 0.017$ up to 17,000 Gallons. [ref. (p) 1. B.]
- A maximum filtration flow rate based on a public pool turnover of six hours. (In other words, the pump flow rate cannot turnover the pool in less than six hours.) [ref. (p) 1. C.]
- A requirement that pumps with a total horsepower of one or more to be multi-speed. [ref. (p) 1. D.]
- That multi-speed pumps have controls that default to the maximum filtration flow rate (two-speed pumps must default to low-speed) within twenty four hours after being switch to a higher seed. [ref. (p) 1. F. & G.]

In reality, the first three bullet points drive the selection of the filtration pump based on a certified pump, the pool gallons, and the six hour turnover limit. This limits the size of the pump which can be used, however smaller pumps may be used as the formula establishes maximums, not minimums.

It should be noted that 36 GPM is the lowest filtration flow rate required, meaning the proposed regulations will not enforce the six hour turnover limit on pools less than 12,960 gallons (The horizontal extension of Curve A from zero gallons to 12,960 gallons, shown in Figure 1). The rationale being skimmers may not function adequately below the GPM.

Section 150 (p) 1. E. addresses “auxiliary pool loads,” requiring the use of a multi-speed pump or a separate pump. This prohibits the use of small pumps (less than 1 HP) for auxiliary feature like waterfalls, solar heating, etc. If a single-speed pump less than 1 HP is all that is needed to power a water feature it should be permitted as there is not an energy savings benefit to California or the pool owner by requiring a separated pump or installing a multi-speed pump.

Suggested revision. Delete this requirement. It does not provided any additional energy savings and it increases installation cost without a corresponding reduction in operating costs.

Section 150 (p) 2. regulates “system piping” by requiring extra pipe in front of the pump, limiting velocity in system piping and by requiring the use of sweep elbows.

Item (p) 2. A., requires the pipe leading into the pump to be four times the pipe diameter (4 x 2” pipe = 8” straight pipe before pump). This is an important design feature for pumps without strainer baskets, however it does nothing for pumps with integrated strainer baskets. Any benefit gained by the straight pipe is lost when the water passes through a strainer basket.

Suggested revision. Add “... for pumps without strainer baskets.”

Item (p) 2. B. limits velocity in return pipe (pressure) to 8 feet per second and in suction pipe to 6 feet per second. These limits are consistent with current ANSI/APSP standards.

Item (p) 2. C. requires the use of “sweep elbows” in place of “hard elbows,” the style typically used. The rationale found in the PGE-SCG_CASE-RESIDENTIAL-SWIMMING-POOLS study (CASE) explains that the reduced friction results in increased system flow rates. Increased flow results in reduced turnover time and therefore energy is saved by allowing the pool to operate less hours per day. However, there is no requirement to run a pool less, therefore there is no means to realize the energy savings found in the CASE study. Without regulating hours of operation, there is no means for the pool owner to recover the additional costs of the sweep elbows. Even if run time was regulated, sweep elbows do not result in energy savings shown in the CASE study example.

For purposes of discussion, assume the precise hours of operation required to maintain water quality is known and the time clock is correctly set to turn off the filtration pump 8.4 minutes earlier (CASE study example p. 22, Table 17) because sweep elbows were used in place of hard elbows, the 2.6% savings are not realized because any savings were already achieved by the velocity limits imposed by item (p) 2. B.

Table 1 illustrates the impact velocity limits impose on potential sweep elbow savings resulting from a reduction in system head. Note the head reductions (Diff) between eight hard 90s and eight sweep 90s (S90) for any given flow rate and velocity. Near the 8 feet per second limit, using eight sweep elbows in place of eight hard elbows only reduces the total system head by 1.8 feet for 1 1/2” fittings and 1.5 feet for 2” fittings. A decrease in system head of one to two feet as may be realized by the new regulation but this has little impact on flow rates.

Suggested revision. Delete Section 150 (p) 2. C., the sweep elbow requirement.

CASE Report Model with Title 24 Velocity Limits

Coefficient Flow	Pool Gallons	Feet of Head		Feet of Head					Feet of Head				
		0.017 Curve A	0.008 Curve C	1.5" fps	4.5 1.5" 90	Diff	2.75 1.5" S90	2" fps	5.5 2" 90	Diff	3.6 2" S90		
60	21,600	61.200	28.800	9.973	9.944	7.181	2.792	4.388	2.847	5.966	2.505	0.865	1.640
0	0	0.0	0.0	0.000	0.0	0.0	0.0	0.000	0.000	0.000	-0.1	0.0	0.0
10	3,600	1.7	0.8	0.386	1.7	0.3	0.1	0.170	0.102	0.994	0.1	0.0	0.1
20	7,200	6.8	3.2	1.323	3.3	1.0	0.4	0.582	0.391	1.989	0.3	0.1	0.2
30	10,800	15.3	7.2	2.751	5.0	2.0	0.8	1.210	0.810	2.983	0.7	0.2	0.5
36	12,960	22.0	10.4	3.842	6.0	2.8	1.1	1.691	1.124	3.579	1.0	0.3	0.6
40	14,400	27.2	12.8	4.668	6.6	3.4	1.3	2.054	1.359	3.977	1.2	0.4	0.8
47	17,000	37.9	17.8	6.358	7.8	4.6	1.8	2.797	1.836	4.695	1.6	0.6	1.1
50	18,000	42.5	20.0	7.076	8.3	5.1	2.0	3.113	2.038	4.971	1.8	0.6	1.2
56	20,016	52.6	24.7	8.638	9.2	6.2	2.4	3.801	2.475	5.528	2.2	0.8	1.4
60	21,600	61.2	28.8	9.973	9.9	7.2	2.8	4.388	2.847	5.966	2.5	0.9	1.6
70	25,200	83.3	39.2	13.361	11.6	9.6	3.7	5.879	3.786	6.960	3.3	1.2	2.2
80	28,800	108.8	51.2	17.238	13.3	12.4	4.8	7.585	4.855	7.954	4.3	1.5	2.8
86	30,960	125.7	59.2	19.800	14.3	14.3	5.5	8.712	5.559	8.551	4.9	1.7	3.2
90	32,400	137.7	64.8	21.606	14.9	15.6	6.0	9.506	6.054	8.949	5.3	1.8	3.5
100	36,000	170.0	80.0	26.463	16.6	19.1	7.4	11.644	7.383	9.943	6.5	2.2	4.3
110	39,600	205.7	96.8	31.811	18.2	22.9	8.9	13.997	8.842	10.937	7.8	2.7	5.1
120	43,200	244.8	115.2	37.648	19.9	27.1	10.5	16.565	10.431	11.931	9.2	3.2	6.0

Table 1

Item (p) 3. requires filters to be sized based on ANSI/NSF-50 standards.

Item (p) 4. requires filter backwash valves to be the same size as the return pipe size, which is driving by the velocity limit of 8 feet per second. Note that velocity calculations are based on auxiliary flow rates when included in the system design. This has the potential of requiring a backwash valve larger than those currently available. For example if the auxiliary flow is for a waterfall using 160 GPM, three-inch pipe and backwash valve is required to meet the 8 feet per second limitation of Section 150 (p) 2. B.