



TITLE 24, PART 6

2028 CODE CYCLE

Welcome to the Statewide CASE Team's Utility Sponsored Stakeholder Meeting

Topics: AWHP Glycol Concentration Limits

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Agenda

Proposal Description

Market and Technical Consideration

Technical Barriers and Solutions

Per Unit Energy and Cost Methodology

Compliance and Enforcement

Discussion and Next Steps

Proposal Description

- Code Change Proposal
- Benefits
- Background Information



Photo credit: Red Car Analytics

Proposed Code Change

1. Establish a maximum concentration of propylene glycol for AWHPs to ensure high efficiency while protecting against freezing/bursting/corrosion
2. Concentration limits scale based on heating design day dry-bulb temperature
3. Exceptions for certain design situations (e.g. heating only or systems with aluminum heat exchangers)

See Title24stakeholders.com
for proposal description,
justification, draft code
language, and requested data

Benefits of the Proposed Change

The Proposed recommendations will

- Reduce unnecessary inefficiencies of excessive glycol use in climates where freezing is less of a concern
- Intervene before poor installation practices become difficult to change as the market rapidly increases in the coming years

Background Information

- Published heat exchanger deratings for high glycol concentrations are significant
- Anecdotal feedback indicating higher than necessary glycol concentrations
- Lab testing underway at Frontier's laboratory to quantify system efficiency impacts of glycol concentration

Glycol Concentration	Pump Power Increase ¹	Heat Exchanger Film Coefficient ²
0%	0.0%	0%
10%	65.2%	-22.0%
30%	192.0%	-58.5%
50%	465.5%	-79.9%

¹ Fluid properties from Dow Chemical sizing tool . <https://www.dow.com/en-us/market/mkt-building-construction/sub-build-heating-cooling-refrigeration/heat-transfer-fluids-calculators.html#tabs-2d02c53560-item-1cd173deb3-tab>

² Average of lowest power draw Grundfos and Taco pump curves that met head for 100 ft of 1 inch PEX pipe at 50F and 12.2 gpm.

Marked-up Code Language

See Title24stakeholders.com for marked-up code language

The following sections would be modified

Title 24, Part 1

- No changes

Title 24, Part 6

- Add Section 110.2(g) under Mandatory Requirements for Space-Conditioning Equipment, limiting propylene glycol concentration to 33% under most circumstances
- Exempt Occupancy Group R buildings

Reference Appendices

- Add sliding scale glycol concentration limits based on heating design day in JA2
- Disallow glycol in JA2 when winter median of extremes is >32F.



Market and Technical Considerations

- Current Conditions and Trends
- Potential Barriers and Solutions
- Technical feasibility

Current Market Conditions

- In California, the number of installed non-residential AWHPs is growing, and new policies encouraging all-electric buildings, new AWHP product lines reaching the market, new financial incentives for AWHPs, and more clear and comprehensive code requirements are encouraging a steady increase in market adoption for all non-residential building types
- Low global warming potential refrigerants like propane are expected to become more common in future years as market barriers are addressed
- No current restrictions on glycol concentration
- Actual glycol concentrations in installed units will be investigated

Poll

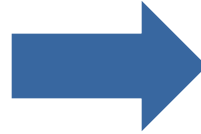
What propylene glycol concentration do you most frequently use for AWHPs in CA?

- a. 0-5%
- b. 5-10%
- c. 11-20%
- d. 21-30%
- e. 31-40%
- f. >40%
- g. I do not know or not relevant to my role

Market Barriers and Solutions

Market Barriers

1. Risk of freezing
2. Lack of training and tools for glycol concentration selection



Potential Solutions

1. Careful lab testing of impacts to heat exchanger effectiveness and analysis of freezing risk by climate
2. New tools and training resources to give designers and installers greater confidence to reduce concentrations

Current Market Share

Market share: percentage of buildings that already use the proposed technology or design practice (at or above the proposed stringency level)

Current Market Share



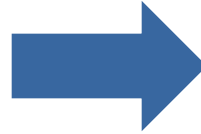
Technical Considerations

- Consequences of high glycol concentrations on AWHP system efficiency have not been clearly quantified
- Specific concentration required to prevent freezing with adequate safety margin is difficult to establish
- Code requirements for glycol concentration could become complicated because of local climate and system design dependence

Technical Barrers and Solutions

Technical Barrers

1. Unquantified effect of glycol concentration on efficiency
2. Difficult to calculate required concentration to ensure freezing doesn't occur
3. Need for relatively simple rules in code



Potential Solutions

1. Lab testing using different glycol concentration, extrapolation using simulations
2. Literature search of freezing incidents combined with fluid system modeling under realistic weather and operating conditions
3. Reasonably sized safety margins, analysis based on extreme local climates within each CA Climate Zone

Poll

How common is pipe freezing for AWHP systems using current practices for addition of glycol?

- a. Never seen it happen
- b. Very rare
- c. Occasionally
- d. Frequently
- e. I do not know or not relevant to my role

Per Unit Energy and Cost Impacts

Methodology and Assumptions

- Energy and Energy Cost Savings
- Incremental Costs



Energy and Energy Cost Savings Methodology

- Using CEC's methodology and metrics
- Model New Construction with default standard design
- Model Alterations with modified standard design
- Standard design will use common rules of thumb for glycol concentration
- Proposed design will impose concentration limits recommended for code adoption

Energy Modeling Assumptions

- Simulating energy savings in EnergyPlus with CBECC rulesets
- Simulating using the following prototypical buildings and climate zones

Prototypical Buildings

- All non-residential building types

Climate Zones

- All climate zones

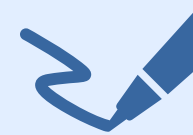
Key Modeling Assumptions

Prototype: All non-residential



Standard Design

1. Typical standard practice glycol concentration as a function of Climate Zone



Proposed Design

1. Maximum allowable glycol concentration specified in code change proposal

Incremental Cost Framework

Prototype(s): All non-residential



Baseline

First Cost

1. Installation costs for glycol based on current practice

30-Year Maintenance Costs

1. Regular Maintenance costs using current practices



Proposed

First Cost

1. Installation costs for glycol based on lower concentrations under proposed code change (potentially lower cost for glycol, smaller pumps due to lower pressure drop)

30-Year Maintenance Costs

1. Regular Maintenance costs using proposed glycol limits

Approach for Gathering Costs

- First cost impacts are likely to be minimal compared to overall AWHP system cost
- Quantify cost savings for reduced amount of glycol
- Estimate additional cost for more methodical calculation of proper glycol concentration instead of possible rules of thumb estimates through interviews with designers and installers
- Model energy cost savings resulting from more efficient system operation in EnergyPlus



Compliance Verification

- Key Aspects of Compliance Verification
- Barriers and Solutions
- Revisions to Compliance Software

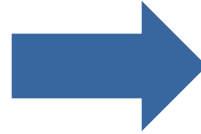
Key Aspects of Compliance Verification

- Documentation of glycol concentration, which can be readily determined in the field using a refractometer
- Determination of relevant concentration limits for the climate zone and system design

Compliance Barriers and Solutions

Compliance Verification Barriers

1. Evidence that concentration limits were met
2. Proof of actual concentration



Potential Solutions

1. Documentation from designers indicating specified glycol concentration complies with established limits
2. Possible test of glycol concentration using a refractometer

Compliance Software Updates

- No changes to compliance software are needed
- Guidance is needed for how much efficiency should be derated as a function of glycol efficiency, climate, and system design

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More information on

CEC's 2028 proceeding website.

We want to hear from you!