# Primer and FAQ for FM Approved Field Erected Fiberglass Counterflow Cooling Towers

This primer is intended to provide some general and detailed explanation on the subject of field erected fiberglass counterflow FM Approved cooling towers. The discussion will cover both single and multi-cell field erected FM Approved classifications. This primer will not address factory assembled cooling towers or other field erected tower classifications. Note: whenever the word Approval is used in reference to an FM Approved product the A is always capitalized. This is an FM designation.

FM Approved field erected counterflow fiberglass cooling towers have historically been preferred or required by customers insured by FM Global. More recently, Approved towers are being requested and considered by a growing number of customers in the HVAC, industrial, and power markets. Many customers, including those not insured by FM Global, recognize the critical nature of their processes and the benefits of third-party certified loss prevention products including evaporative water cooling towers.

1. **Who are the key players in the world of FM Approved cooling towers and what do they do?**
   FM Global is the world's largest industrial and commercial insurance company covering 27% of the world's facilities. FM Global can be quickly described as follows:

   - A US based 175 year old insurance company
   - Insurer of 130,000+ locations in 130+ countries
   - Covers property damage and business interruption
   - Believes that "loss is preventable through engineering"
   - FM Global field engineers and underwriters interact with their customers to determine the selection of equipment for projects and related insurance premium costs
   - For more information visit FM Global at http://www.fmglobal.com

   FM Approvals is a subsidiary of FM Global. FM Approvals is the engineering and testing branch of the operations and can be described as follows:

   - Establishes *Standards* for products and administers the approval process
   - Approves a variety of building materials and products including water cooling towers
   - Provides independent third-party certification of certain materials and products including water cooling towers
   - Conducts audits of combustible component manufacturers
   - Conducts testing at its Natural Hazards testing Laboratory in Rhode Island
   - Certifies products and services with a unique focus on:
     - Objectively testing products and certifying those that meet rigorous loss prevention Standards
     - Encourages the development and use of FM Approved products and services that advance property loss prevention practices
   - For more information visit FM Approvals at http://www.fmglobal.com/page.aspx?id=50000000

2. **What is an FM Approved cooling tower?**
   An FM Approved cooling tower is one that has satisfied the historic testing protocol or one that has satisfied the requirements and acceptance criteria of *Approval Standard for Cooling Towers (Class 4930).* There is a significant distinction between these two types of Approved products as discussed later. The *Standard* is dated May 2009 and became effective May 31, 2010.

3. **How does a cooling tower become FM Approved; what is the process today?**
   The process of getting a cooling tower product Approved is lengthy and very expensive. FM Approvals classifies the products it Approves using a number system. Cooling towers are defined as Class 4930. A manufacturer applies for Approval for Class 4930 products and commits to a substantial investment for FM Approvals services as well as product fire testing costs. Audits of combustible components are conducted in advance of required testing. A variety of tests described later are conducted by or witnessed by FM Approvals.

   Once the testing success criteria have been satisfied FM Approvals prepares an Approval Report, issues a Certificate of Compliance, and adds the Approved product to the Approval Guide. Once a product is Approved its combustible component manufacturers are audited annually to confirm compliance with the Approved product certification. The manufacturer of an Approved product is required to notify FM Approvals of changes to product construction, components, raw materials, physical characteristics, coatings, component formulations or quality assurance procedures prior to implementation.

   The Approval process has recently changed. There are two eras of FM Approved cooling towers; the historic and the modern eras.

4. **What are the major differences between the historic and modern eras?**
   The eras are distinctly different in terms of their time, testing requirements, and acceptance criteria. Let's explore the details.

   **Historic Era Approval Requirements:**

   - The historic era precedes May 2009 when FM Approvals first introduced its *Approval Standard for Cooling Towers (Class 4930).* The historic testing process was actually a protocol that was not formalized as a *Standard.* The process was defined in proposals presented to manufacturers seeking product Approval. The protocol required three elements to be satisfied for Approval to be granted as follows:
     - **Full-scale fire test:** Heptane was used as the source of ignition placed in the corner of a tower under the fill. The test was successful if the fire was contained to the cell of origin and did not spread over, under, around, or through the cell walls and partitions to adjacent cells.



8331 Nieman Road | Lenexa, KS 66214 | 913.322.5165 | marketing@evaptech.com | www.evaptech.com

Thermal Redundancy: For FM Approved cooling towers, FM Global's Loss Prevention Data Sheets (paragraph 1.0 Scope) prescribe one additional cell must always be provided so sufficient capacity will always be available. The additional cell requirement has become known as the N + 1 rule. The Data Sheets also comment that the adequacy of the extra capacity should be verified for the intended purpose during the acceptance process.

- **Flammability characterization testing:** This laboratory testing established certain measurable characteristics and values of combustible materials. Flammability characterization testing can serve two purposes: (1) to verify a component complies with the Approved product certification or, (2) to determine if a substitute component with comparable characteristics and values is acceptable without compromising the product's Approval status.
- **Initial and annual surveillance audits of combustible components**: These audits serve to initially record and eventually monitor fully functional cooling tower product details in terms of members and component sizes, configurations, and material formulations. The manufacturing processes and material formulations for all combustible components are also audited. Approved product and component formulations and configurations cannot be changed or altered without additional testing and verification by FM Approvals. Manufacturing sources cannot be changed without additional audits by FM Approvals. The goal of the audits is to assure the Approved product and its combustible components are consistently produced and constructed to be identical to the Approved product.

- There are no single cell fiberglass cooling towers that passed the historic protocol. Only multi-cell fiberglass towers have passed the historic full-scale fire tests.

**Modern Era Approval Requirements:**

- The modern era testing process is much more comprehensive than the historic era process. The modern era testing requirements and acceptance criteria are explicitly defined by the *Approval Standard for Cooling Towers (Class 4930)* dated May 2009. The *Standard* became effective May 31, 2010, marking the beginning of the modern era.

  Manufacturers seeking Approval <u>after</u> the effective date are required to comply with the *Standard*. Manufacturers with products Approved during the historic protocol period and <u>before</u> May 31, 2010 are required to have their products certified to the *Standard* to maintain their Approved status. Otherwise, the Approval based on the historic protocol is forfeited. Previously Approved products are granted a full-scale fire test exemption however, the product must pass all other requirements of the *Standard*.

  The *Standard for Cooling Towers(Class 4930)* has several elements:

  - **Full-scale fire test:** The fire test is the same for both eras. Heptane is used as the source of ignition placed in the corner of a tower under the fill. The test is successful if the fire is contained to the cell of origin and does not spread over, under, around, or through the cell walls and partitions to adjacent cells.

    Thermal Redundancy: The acceptance criteria for the full-scale fire test in the *Standard* is very different from the historic test protocol. As in the case of the historic era test protocol, the fire must be contained to the cell of origin AND the new *Standard* requires the remaining cells must be able to provide at least 75% of the design capacity of the tower after a fire. This success criteria applies to both single and multi-cell cooling towers.
  - **Flammability characterization testing:** This testing has not changed from the historic era. Laboratory testing establishes certain measurable characteristics and values of combustible materials including the TRP (Thermal Response Parameter) and CHRR (Chemical Heat Release Rate). Flammability characterization testing can serve two purposes: (1) to verify a component complies with the Approved product certification or, (2) to determine if a substitute component with comparable characteristics and values is acceptable without compromising the product's Approval status.
  - **Initial and annual surveillance audits of combustible components:** Audit requirements for both eras are the same. These audits serve to initially record and eventually monitor fully functional cooling tower product details in terms of members and component sizes, configurations, and material formulations. The manufacturing processes and material formulations for all combustible components are also audited. Approved product and component formulations and configurations cannot be changed or altered without additional testing and verification by FM Approvals. Manufacturing sources cannot be changed without additional audits by FM Approvals. The goal of the audits is to assure the Approved product and its combustible components are consistently produced and constructed to be identical to the certified product.
  - **Airborne Debris (Missile) Testing (new requirement):** This is a new requirement included in the *Standard*. Testing involves launching a 2 x 4 "missile" at a full-scale fan cylinder and also at the cooling tower casing system. Testing is successful if the damage does not hinder rotation of the fan assembly and if damage allowing air leakage within the casing system does not reduce the operating capacity of the tower by more than 10%.
  - **Static and Cyclic Pressure Testing (new requirement):** This is a new requirement included in the *Standard*. Testing involves subjecting the cooling tower casing system to both static and cyclic pressures on both the windward and leeward sides of the casing system. The tests involve literally thousands of cycles and very high pressures. This testing is intended to simulate the wind forces on cooling tower casing systems one might expect during a severe storm or hurricane. The wall system testing is considered acceptable if damage allowing air leakage does not reduce the operating capacity of the tower by more than 10%.
  - **Seismic (Ice and Snow) Analysis (new requirement):** This is a new requirement included in the *Standard*. This is a computational analysis of the manufacturer's design methodology based on seismic, snow, and ice loads prescribed by FM Approvals. The FM Approvals loads exceed those normally defined in International Building Codes.

## COMPARISON OF THE HISTORIC AND NEW *STANDARD* TESTING REQUIREMENTS

| | Historic Era | Modern Era (new *Standard*) |
|---|---|---|
| Time period | Before May 31, 2010 | After May 31, 2010 |
| Full-scale burn test | Required | Required (previously Approved products are exempt) |
| Exam of combustible materials | Required | Required |
| Quality control audits | Required | Required |
| Flammability testing | Required | Required |
| Windborne debris testing | Not required | Required (new) |
| Static and cyclic pressure testing | Not required | Required (new) |
| Live load analysis (seismic) | Not required | Required (new) |

## COMPARISON OF THE HISTORIC AND NEW *STANDARD* COMBUSTIBILITY ACCEPTANCE CRITERIA

| | Historic Era | Modern Era (new *Standard)* |
|---|---|---|
| Criteria #1 - Containment | Contain damage from fire to cell of origin | Contain damage from fire to cell of origin; fire may not spread over, under, around, or through the walls and partitions to adjacent cells |
| Criteria #2 - Post Fire Required Thermal Capacity | None | Remaining cell (single cell classification) or cells (muti-cell classification) must provide at least 75% design capacity after fire (75% rule) |
| Thermal Redundancy (interpreted as over-sized or extra cells) | Extra cell per FM Property Loss Prevention Data Sheets (N + 1 rule) | To meet post fire minimum thermal capacity the number and size of the cells depends on the Approval classification:<br><u>For standard PVC components (multi-cell Approval):</u><br>• If the design requires 1 cell then 2 cells @ 75% design capacity per cell must be provided<br>• If the design requires 2 cells then 2 cells of at least 75% design capacity per cell must be provided<br>• If the design requires 3 cells than 3 cells of at least 37.5% design capacity per cell must be provided<br>• If the design requires 4 cells or more there is no redundancy requirement<br><u>For custom PVC components (single cell Approval that can also be applied to multi-cell towers):</u><br>• No redundancy required |

**5. How do you know if a product is Approved and what the basis of Approval is?**

Once a cooling tower product is Approved under either process a Certificate of Compliance from FM Approvals is issued to the manufacturer. If the Approval granted date on the Certificate of Compliance occurs before May 31, 2010 the product was Approved using the historic testing protocol. If the Approval granted date occurs after May 31, 2010 (effective date of the *Standard*) the product is Approved per the *Standard.*

Approved towers are also listed and described in the Approval Guide online at http://www.approvalguide.com. To view the Guide you must register on the website. Once you enter the Guide go to the drop down menu under the Division tab in the upper left hand corner and click on the Building Materials to proceed to the cooling tower listings. Fiberglass field erected towers are found under the multi-cell and single cell listings. Each listing provides product details.

The Approval Guide distinguishes products that are Approved according to the *Standard* from those that were Approved prior to the *Standard* based on the historic process. The products that are Approved according to the *Standard* will have a product listing that begins with a wind load rating and zone table. None of the historically Approved products have such a rating table.

Approved towers can be physically identified by the FM Approvals diamond mark attached to the installed cooling tower

**6. Explain the different cooling tower Approval classifications for field erected towers.**

The FM *Approval Standard for Cooling Towers* recognizes both single cell and multi-cell cooling towers. Both classifications must satisfy all the requirements of the *Standard*. The requirements for both classifications are the same including the combustibility acceptance criteria.

A single cell Approved product is unique because the single cell must provide at least 75% of thermal design capacity after a fire. In other words, the single cell must remain essentially intact and undamaged during the full-scale fire test. A product that is Approved as a single cell does not require any thermal redundancy and a multi-cell product using the same design and components my be applied without any thermal redundancy.

**7. What Approvals does EvapTech have?**

EvapTech has three FM Approved cooling tower designs as follows:

- Multi-Cell with standard PVC fill and eliminators requiring redundancy stated above
- Single cell with custom PVC fill and eliminators requiring no thermal redundancy
- Multi-Cell with custom PVC fill and eliminators requiring no thermal redundancy

**8. Are the components of a cooling tower such as fill or fans FM Approved?**

Only FM Approved products such as complete cooling towers are certified as Approved. Individual components of complete cooling towers are not Approved. There is a distinction to be made regarding the answer to this question. Components used in FM Approved towers may provide their owners and operators certain benefits however, the components themselves are not Approved. The FM Global Property Loss Prevention Data Sheets (paragraph 2.2.1.1.b) recognize the use and benefits of fill components from Approved cooling tower products. For non-Approved towers the Data Sheets allow the reduction in required fire protection system water densities and the type of protection system required when such fill components are used.

**9. Does FM Global recognize an alternative to FM Approved cooling towers?**

- The FM Global Property Loss Prevention Data Sheets (paragraph 1.0) advises that cooling towers that are not FM Approved should be protected using a fire protection system. The requirements for a fire protection system according to the Property Loss Prevention Data Sheets are more stringent and demanding that those found in the commonly applied code NFPA-214 Standard on Water-Cooling Towers. In the case of a counterflow tower the fire protection system must be a deluge type compared to the less expensive and more common closed head dry pipe type system. Further, the minimum coverage densities (gal/min $ft^2$) may be different from NFPA-214. The use of fill from an Approved product may allow the use of a dry pipe system with reduced water densities. FM Global does not "approve"cooling towers with fire protection systems nor are such "protected" towers to be confused with those that are Approved.

**10. How can I learn more about FM Approved cooling towers?**

Contact EvapTech to obtain the following references and resources for additional information:

- *Approval Standard for Cooling Towers* Class Number 4930 (May 2009)
- Property Loss Prevention Data Sheets
- Understanding the Benefit
- Understanding the Hazard
- EvapTech's Certificate of Compliance

Or, visit these websites:

- FM Global website: http://www.fmglobal.com
- FM Approvals website: http://www.fmglobal.com/page.aspx?id=50000000
- FM Approvals Guide: http://www.approvalguide.com



8331 Nieman Road | Lenexa, KS 66214 | 913.322.5165 | marketing@evaptech.com | www.evaptech.com