



Approval Standard for Cooling Towers

Class Number 4930

November 2013

©2013 FM Approvals LLC. All rights reserved.

Foreword

Approvals are intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of Approval Standards is to present the criteria for Approval of various types of products and services, as guidance for FM Approvals personnel, manufacturers, users and authorities having jurisdiction.

Products submitted for Approval shall demonstrate that they meet the intent of the Approval Standard, and that quality control in manufacturing and/or applications shall ensure a consistently uniform and reliable product or service. Approval Standards strive to be performance-oriented and to facilitate technological development.

For examining equipment, materials and services, Approval Standards:

- a) must be useful to the ends of property conservation by preventing, limiting or not causing damage under the conditions stated by the Approval listing; and
- b) must be readily identifiable.

Continuance of Approval and Listing depends on compliance with the Master Agreement, satisfactory performance in the field, on successful re-examinations of equipment, materials, and services as appropriate, and on periodic follow-up audits of the manufacturing facility or service/application.

FM Approvals LLC reserves the right in its sole judgment to change or revise its standards, criteria, methods, or procedures.

TABLE OF CONTENTS

1 INTRODUCTION	1
1.1 Purpose.....	1
1.2 Scope.....	1
1.3 Basis for Requirements	1
1.4 Basis for Approval	2
1.5 Basis for Continued Approval.....	2
1.6 Effective Date	2
1.7 System of Units.....	2
1.8 Applicable Documents.....	3
1.9 Definitions.....	3
2 GENERAL INFORMATION.....	5
2.1 Product Information	5
2.2 Approval Application Requirements.....	5
2.3 Requirements for Samples for Examination	6
3 GENERAL REQUIREMENTS	6
3.1 Markings	6
3.2 Manufacturer's Installation and Operation Instructions.....	7
3.3 Drawings/Plans/Specifications Required	7
3.4 Calibration.....	7
3.5 Manufacturer's Responsibilities.....	7
3.6 Review of Documentation.....	7
3.7 Formulation Changes	7
3.8 Configuration Changes – Fill	8
3.9 Seismic Loads	8
3.10 Wind Loads	10
4. PERFORMANCE REQUIREMENTS.....	11
4.1 Combustibility – Single Cell Towers.....	11
4.2 Combustibility – Multi Cell Towers	11
4.3 Combustibility – Roof Top Mounted Cooling Towers (Single Cell or Multi Cell).....	12
4.4 Flammability Characterization for Cooling Tower Fill	12
4.5 Large Missile Impact on Walls and Fan Stacks	12
4.6 Static and Cyclic Air Pressure Differentials	13
4.7 Comparative Testing for Alternate Cooling Tower Fill and Drift Eliminators.....	13
4.8 Comparative Testing for Alternate Cooling Tower Components other than Fill and Drift Eliminators.....	14
5 OPERATIONS REQUIREMENTS.....	14
5.1 Demonstrated Quality Control Program	14
5.2 Facilities and Procedures Audit (F&PA)	15
5.3 Installation Inspections.....	15
5.4 Manufacturer's Responsibilities.....	16
APPENDIX A: Units of Measurement	17
APPENDIX B: FM Approvals Certification Marks	18

1 INTRODUCTION

1.1 Purpose

- 1.1.1 This standard states Approval requirements for cooling towers and cooling tower components. Cooling towers or cooling tower components that meet the requirements of this standard do not need automatic sprinkler protection.
- 1.1.2 Approval criteria may include, but are not limited to, fire, wind, ice, snow and seismic performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a follow-up program.

1.2 Scope

- 1.2.1 This standard sets the requirements for cooling towers constructed with combustible and non-combustible components. Typical combustible components may include, but are not limited to, structural carrying/support members, fill, drift eliminators, louvers, fan, fan deck, piping, enclosure walls or partition walls.
- 1.2.2 This standard applies to both factory assembled and field erected cooling towers. The cooling towers that meet the requirements for combustibility, as well as wind, ice, snow, and seismic loads, shall be eligible for Approval.
- 1.2.3 The fire performance of a cooling tower depends in part on the size, configuration and material formulation(s) of the individual components when assembled into a functional cooling tower. It is therefore necessary to evaluate these products as assembled units. These assembled units are included within the standard tests.
- 1.2.4 This standard is intended to verify that the systems as described will meet the stated conditions of performance, safety and quality useful to determine the suitability for end-use conditions of these products. The cooling tower manufacturer is responsible for the design of the thermal capacity of the cooling tower and to meet corrosion resistance requirements dictated by the end use of the tower.
- 1.2.5 The quantity and toxicity of the products of combustion are not analyzed as part of this standard. Additional precautions by the user may need to be taken if the product is utilized near an area susceptible to smoke damage.

1.3 Basis for Requirements

- 1.3.1 The requirements of this standard are based on experience, research and testing. The advice of manufacturers, users, trade associations and loss control specialists was also considered.
- 1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of cooling towers for the purpose of obtaining FM Approval. These requirements are intended primarily as guides, and strict conformity is not always mandatory. Cooling towers having characteristics not anticipated by this standard may be Approved if performance equal, or superior, to that required by this standard is demonstrated, or if the intent of the standard is met. Alternatively, cooling towers which do meet all the requirements identified in this standard may not be Approved if other conditions which adversely affect performance exist or if the intent of this standard is not met.

1.4 Basis for Approval

Approval is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

- 1.4.1 The Approval examination and tests on production samples to evaluate the combustibility, fire and wind hazard properties of the cooling tower and an engineering evaluation of the structural design to determine the ability of the assembly to adequately withstand certain live loads, including wind and seismic. A complete review of the product as well as construction specifications shall be conducted to ensure, as far as possible, a practical and reliable installation.
- 1.4.2 An examination of the manufacturing facilities and audit of quality control procedures is made to evaluate the manufacturer's ability to consistently produce the product which is examined and tested, and the marking procedures used to identify the product. These examinations may be repeated as part of FM Approvals' product follow-up program.

1.5 Basis for Continued Approval

Continued Approval is based upon:

- Production or availability of the product as currently FM Approved;
- The continued use of acceptable quality assurance procedures;
- Satisfactory field experience;
- Compliance with the terms stipulated in the Approval report;
- Satisfactory re-examination of production samples for continued conformity to requirements;
- Satisfactory Facilities and Procedures Audits (F&PA's) conducted as part of FM Approvals' product follow-up program.

Also, as a condition of retaining Approval, manufacturers may not change a product or service without prior authorization by FM Approvals.

1.6 Effective Date

- 1.6.1 The effective date of an Approval standard mandates that all cooling tower products or components tested for Approval after the effective date shall satisfy the requirements of this standard. Products Approved under a previous edition shall comply with the new version by the effective date or else forfeit Approval.
- 1.6.2 The effective date of this standard is May 31, 2010 for compliance with all requirements.

1.7 System of Units

Units of measurement used in this standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Appendix A lists the selected units and conversions to SI units for measures appearing in this standard. Conversion of U.S. customary units is in accordance with the American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)/American Society for Testing Materials (ASTM) SI 10-97, *Standard for Use of the International System of Units (SI): The Modern Metric System*.

1.8 Applicable Documents

The following standards, test procedures, test methods, and practices are referenced in this standard:
Procedure Class Number 4930: Full-Scale Fire Test Procedure for Cooling Towers

Procedure Class Number 4930: Intermediate Scale Fire Test Procedure for Fill and Drift Eliminator Components for Cooling Towers

Procedure Class Number 4930: Intermediate Scale Fire Test Procedure for Components Other Than Fill and Drift Eliminators for Cooling Towers

Procedure Class Number 4881: Test Method for Exterior Wall Systems Impacted by Windborne Debris

Procedure Class Number 4881: Structural Test Method for Exterior Walls Using Cyclic Air Pressure Differentials

Approval Standard 4881, Class 1 Exterior Wall Systems (November 2007)

FM Global Property Loss Prevention Data Sheet 1-2, *Earthquakes*, May 2008

FM Global Property Loss Prevention Data Sheet 1-6, *Cooling Towers*, January 2006

Seismic Approval of Cooling Towers (by Praveen K. Malhotra, FM Global Research, Senior Research Specialist, Jan 07)

ASTM E2058, "Standard Test Methods for Measurement of Synthetic Polymer Material Flammability Using a Fire Propagation Apparatus (FPA)"

1.9 Definitions

For purposes of this standard, the following terms apply:

Cold Water or Water Collection Basin – A collection pan located at the base of the cooling tower to receive the cold water after it has run down through the fill material and direct it from the tower.

Crossflow Cooling Tower – A cooling tower in which the cooling air flows horizontally across the falling water. These units may have one or two sets of fill. When two sets of fill are present, they are generally located opposite one another and are separated by an open plenum. To provide for cooling air flow, these units may have a top mounted horizontal fan (induced mechanical draft), a bottom mounted fan (forced mechanical draft), a large hyperbolic stack (natural draft), or a combination (fan and hyperbolic stack).

Counterflow Cooling Tower – A cooling tower in which the cooling air flows vertically upward against the falling water. Typically these units will have one set of fill. To provide for cooling air flow, these units may have a top mounted horizontal fan (induced mechanical draft), a side mounted vertical fan(s) (also, induced mechanical draft), a bottom mounted fan (forced mechanical draft), a large hyperbolic stack (natural draft), or a combination (fan and hyperbolic stack).

Distribution System – The method used to distribute the warm water throughout the cooling tower.

Drift Eliminators – Drift eliminators are located on the leeward or exit air side of the fill material and catch or stop small particles of water (drift) from exiting the tower.

Factory Assembled Cooling Towers – Cooling towers which are fabricated in a factory and are delivered to their destination as a complete unit. These are generally small in size allowing them to be located on building roofs as well as at ground level.

Fan Blades – Mechanical device used for drawing or forcing cooling air through the cooling tower.

Fan Cylinders (Stack) – The area of the cooling tower which encircles the fan blades through which the cooling air travels.

Fan Deck – The uppermost horizontal surface of a cooling tower upon which the fan stack is located.

Field Erected Cooling Towers – Cooling towers in which individual components arrive separately at a site where they are assembled in place. These towers are generally much larger in size than the factory assembled towers.

Fill Material – The medium over which hot water flows within the cooling tower to provide a continuous water film (wetted surface) as cooling air flows past it to remove heat from the water, thus providing an efficient cooling capacity of the tower.

Flexible Cooling Tower – A cooling tower shall be considered flexible if its fundamental natural mode of vibration has a period greater than or equal to 0.033 second (i.e., fundamental natural frequency less than or equal to 30 Hz). The manufacturer shall demonstrate through rigorous testing or analysis that the cooling tower is either rigid or flexible. A spring-mounted (vibration isolated) cooling tower shall always be considered flexible.

Forced Draft Cooling Tower – A mechanical draft cooling tower where the fan and drive are located below and perpendicular to the fill and force cooling air through the fill, past the dripping water and out the exhaust stack of the tower. Forced draft cooling towers are usually counterflow type cooling towers.

Induced Draft Cooling Tower – A mechanical draft cooling tower where the fan is located at the top (air exhaust) of the tower and draws the cooling air through the fill, past the dripping water. Induced draft cooling towers may be either crossflow or counterflow type cooling towers.

Louvers – Blades located on the windward or entering air side of the fill material and direct the air into the fill and help contain the falling water within the tower.

Mechanical Draft Cooling Tower – A cooling tower in which fans are used to provide a continuous movement of cooling air. These types of towers fall into two basic categories: Induced Draft or Forced Draft

Natural Draft (Hyperbolic) Cooling Tower – A cooling tower with a very high vertical stack in which air movement is provided by the stack effect resulting from the difference in density between two interconnected columns of air at different temperatures. As warm air rises it draws in cool air from below.

Rigid Cooling Tower – A cooling tower shall be considered rigid if its fundamental natural mode of vibration has a period less than 0.033 second (i.e., fundamental natural frequency greater than 30 Hz). The manufacturer shall demonstrate through rigorous testing or analysis that the cooling tower is either rigid or flexible.