IBC CERTIFICATION PROGRAM

VMC Group

APPROVAL STANDARD

For Special Seismic Certification

VMA 1826

Revision 3
May 1, 2015

Approval Standard for Seismic Certification for Nonstructural Building Components

APPROVAL STANDARD FOR SEISMIC CERTIFICATION FOR NONSTRUCTURAL BUILDING COMPONENTS

VMA 1826

2015 Rev. 3

Authors

John Wilson Jr., Chief Executive Officer, The VMC Group

John P. Giuliano, President, The VMC Group

Contributing Editor

Brett Wyckoff

Foreword

The VMC Group Special Seismic Certification Mark (VMA) is intended to verify that the products and components described meet the Approval Standards in accordance with property preservation.

The VMA certification purpose is the assurance that after a Design Earthquake the designated seismic system shall maintain structural integrity and functionality in accordance with the Certification Scope.

Components submitted for Seismic Certification to The VMC Group shall demonstrate that they meet the intent of the Approval Standards and that the manufacturer's quality control procedures will continue to ensure a consistent and reliable product. Approval Standards seek to maximize performance and to facilitate technological advancements.

The scope of the VMA Approval is limited to:

> Components that require special seismic certification in accordance with ICC-ES AC156
>
> **Or**
>
> Components that require Special Seismic Certification in accordance with the International Building Code® (IBC®) Chapters 16 & 17 for ASCE7-10 Section 13.2.2

Maintaining approved VMA status depends on compliance with the standards outlined in the Approval Agreement, acceptable performance during field operation, satisfactory re-examination results of equipment, components, materials and services if deemed necessary and thorough completion of an annual engineering and quality assurance audit of the product at each manufacturing facility.

The VMC Group is a Certified Seismic Qualification Agency.

Table of Contents

List of Equations

List of Tables

Appendices

1. INTRODUCTION

1.1 Purpose

The purpose of this standard is to certify, by qualification testing and analysis, components and products manufactured to meet the post-earthquake functional requirements of building codes. The components and products must prove capable of structurally and operationally withstanding the seismic loading criteria as defined in building codes based on the International Building Code® (IBC®) standards.

The outcome of this standard will present criteria for VMA Approval as guidance for The VMC Group personnel, manufacturers, equipment users and all jurisdictional authorities.

1.1.1 Seismic Certification History

The single largest influence on the development of building codes over the past forty years has been the observation of the behavior of real buildings during an earthquake event. A lull of earthquake activity in populated areas within the United States between 1940 and 1970 gave a false sense of security at a time when population growth was dramatically on the upswing in metropolitan areas – particularly in California.

Two California earthquakes forever changed the building code requirements for structural and nonstructural components. In 1971 a 6.6 magnitude quake occurred in a sparsely populated area of the San Gabriel Mountains, near San Fernando. Lasting just 12 seconds, the quake caused property damage of more than $500 million in the Los Angeles area, while taking 65 lives and injuring more than 2,000. The majority of deaths happened at two healthcare facilities, the Olive View Health Medical Center and Veterans Hospital. Both facilities featured mixed construction styles and seismometers established by local ordinances in areas nearby were able to measure the extraordinary amount of strong motion data recorded during the event.

This quake served as a wakeup call to California and the rest of the country. Legislators quickly passed laws focused on health care facilities calling for the application of medical facility safety standards on all new hospital construction. Many changes were also made to the building code, including:

- The effect of site conditions on ground shaking intensity was reintroduced into the code as an ‘S’ coefficient within the base shear formula.

- The continued observance of very poor performance of concrete frame elements led to 1973 code requirements that all concrete frame elements designed to resist earthquake forces must be detailed for ductile performance.

- The 1994 Northridge earthquake provided many more lessons on how buildings respond to major seismic activities. One such learning was retrofitted hospitals stood up nicely to this quake, but failures to

nonstructural building components like HVAC, plumbing and power generation systems caused the hospitals to close down during the height of the emergency. In 2007, California adopted the IBC® Building Code into its California Building Code® (CBC®). The California Office of Statewide Health Planning and Development (OSHPD) had to comply with the Special Seismic Certification provisions that were required to prove that nonstructural building components, such as HVAC equipment would remain functional after an event. While the rest of the country was reeling in the aftermath of the Lehman Brothers' bankruptcy, and the commencement of the Great Recession, California had received and was spending billions of dollars in retrofitting hospitals to meet various regulations, including seismic compliance. OSHPD, being the AHJ (authority having jurisdiction), for hospitals in California, quickly commenced a pre-approval program for an OSHPD Special Seismic Certification which assigns a pre-approval "OSP" number for the nonstructural building equipment that is tested and accepted by OSHPD. While the rest of the country was in an economic collapse and building construction was coming to a halt, manufacturing companies seeking to sell equipment in one of the only viable markets in the country at the time, California hospitals, quickly moved to comply with the new shake table testing requirements. National and regional engineering firms lined up to provide the shake table services.

- A few companies, including The VMC Group, with our decades of engineering, testing and manufacturing isolation components for nonstructural equipment use, chose to become a Certified Seismic Qualification Agency. Since 2003, The VMC Group has been providing seismic testing and certification for equipment manufacturers. The VMC Group has expanded our services to include a path for continued compliance and is currently the only agency with this capability.

1.2 Scope

This standard encompasses the design and performance qualifications for seismic certification of nonstructural building components for manufacturers of designated seismic system components.

The general requirement for Special Seismic Certification is to test and analyze the component and its mounting system or anchorage and to submit a Certificate of Compliance (C of C) for review and acceptance by the registered design professional responsible for the designated seismic system, and for approval by the appropriate building official or entity.

To gain evidence of compliance any or all of the following may be involved: shake table testing, three-dimensional shock tests, analytical methods using dynamic characteristics and forces, use of experience data or by more rigorous analysis if needed to ensure equivalent safety. However, to achieve VMA Certification for active and energized components, the component shall include physical shake testing, unless exempted per §1.7, performed by a certified tester (see §4.1.3). All testing

shall be under the responsible charge of an independent US licensed professional engineer.

The intent of the certification process is to establish a well-defined, predetermined consistent and controlled method to the Special Seismic Certification (SSC) of a manufacturer's equipment. Special Seismic Certification is defined per ASCE7.

Approval standards are intended to verify that the product described will meet stated conditions of performance, safety, and quality through the useful life of the equipment.

1.3 Basis for Requirements

The requirements of this standard are based on experience, analysis, testing, research, and/or standards of other organizations. Advice from manufacturers, equipment users, trade associations, jurisdictions, and/or loss control and other safety specialists may also be considered.

The underlying assumptions for defining the research, analysis, testing and development of this Approval Standard are based on adhering to the list of building codes and design standards that follow. All equipment certified will be in compliance with the seismic criteria for one or more of the following references:

IBC® 2000, 2003, 2006, 2009, 2012
CBC® 2010, 2013
ASCE7-98, 7-02, 7-05 and 7-10
OSHPD Code Application Notice (CAN) 2-1708A.5

The requirements of this standard reflect tests and practices used to examine characteristics of the product following a controlled seismic event for the purpose of obtaining approval. Components and assemblies having characteristics not anticipated by this standard may be VMA Approved if performance equal to, or superior, to this standard is achieved, or if the intent of the standard is met. Alternatively, if other conditions that adversely affect performance exist, or if the intent of the standard is unmet, the component may not be VMA Approved.

1.4 Basis for Approval

Approval is achieved upon satisfactorily completing a comprehensive implementation methodology that includes the following stages:

1.4.1 Project Initiation (Kick-off)

Includes review of project scope, extensive definition development, creation of testing matrices, engineering plan development, project time and more.

1.4.2 Detailed Product Review

Determines and confirms design breaks based on similarity of construction, planning meeting with jurisdiction authorities, conducting pre-shake "confidence analysis" and more.

1.4.3 Finite Element Analysis

Establishes stress, buckling and modal modeling results to define design change requirements and manufacturer acceptance parameters.

1.4.4 Shake Test Planning

Identifies test specimens and development of pre-shake and post-test function definitions, analysis planning and confidence analysis.

1.4.5 Shake Testing

Includes managing pre-testing and functional verification, installation including external isolation (if applicable), post shake inspection/verification, post process accelerometer data and more.

1.4.6 Discrete Analysis

Notates calculations performed on all mission-critical elements resulting in updated design change requirements and acceptance criteria. Analysis of interpolated and extrapolated product line and untested supports and attachments.

1.4.7 Installation Requirements

Defines any necessary design update changes including anchor calculations, isolator selections, service connections, sway bracing and support structure.

1.4.8 Certificate of Compliance/Labels

Includes designing customer label and creating the initial Certificate of Compliance for manufacturer review and comment.

1.4.9 Initial Certification Report

Involves creating and writing the initial IBC® Certification Report and completing the OSHPD OSP application and submittal packages (if applicable).

1.4.10 Final Documentation

Incorporates manufacturer comments in a report and on a label; assigns VMA numbers and posts to the certification site www.IBCapproval.com; drives meeting, if necessary, with jurisdiction authorities; and submission of jurisdiction certifications.

Specifically, the acceptance criteria after shake table testing shall be as required by ICC-ES AC156 to ensure structural integrity of components, that supports and attachments shall be maintained and that functionality of components are equivalent to pre-shake test functionality. However, the

complete methodology needs to be followed and completed prior to VMA Approval and Certification.

An additional requirement for approval is the manufacturer's agreement to adhere to using the VMA Approval Certification marks as shown in **Appendix B**. These certification marks must be used as shown in conjunction with products that have been VMA Approved by The VMC Group and currently adhere to all Approval Standards. Any alterations, including additions or deletions from these Approval Certification Marks, are unacceptable and could lead to VMA Approval nullification.

1.5 Maintaining Certification

1.5.1 Primary Maintenance Criteria

- Production or availability of the approved product design is current.
- The continued use of accepted quality assurance procedures.
- Competent field experience.
- Compliance with the terms stipulated in the approval agreement.
- Successful re-examination of production samples to ensure conformity to approval requirements.
- Satisfactory completion of an engineering and quality assurance audit of the product or products at each manufacturing facility.

1.5.2 Nullification Circumstances

- Design, construction or quality control/quality assurance methods are materially altered as defined in the California Administrative Code, 2013 Section 7-111.
- Strength, stiffness, size, weight, materials, support, orientation or manufacturer are changed/altered so the product attributes are no longer equivalent to what was approved in the VMA.
- Inappropriate usage of approved VMA Approval Certification Marks
- Nonpayment of fees

1.6 Effective and Expiration Dates

The effective date of a VMA Approval affirms that all products manufactured after the effective date, satisfy the requirements of that standard. Any previously approved editions of these products must comply with the new version by the effective date or approval is forfeited. Expiration is three years from the original date of approval.

1.7 Exemptions

Active and energized sub-components that are deemed rugged and have previously completed seismic shake table testing successfully on multiple occasions in accordance with AC156-2007 or newer (more than once and separate testing events), in the same mounting configuration within a multi-component systems, can be approved in other installations if it can be proven that the new support has equivalent strength and stiffness as the previously tested component's support. The substantiated seismic capacities, based solely on the previous testing, must equal or

exceed the seismic demand for the new certification for the exemption to meet the requirements of section 1.4. The exemption must meet the requirements of ASCE7-10 Sections 13.2.2 & 13.2.6

1.8 Systems of Units

The units of measurement used in this standard are United States (U.S.) customary units. **Appendix A** lists the selected units and shall be regarded as the requirement. Following each unit in parenthesis are the arithmetic equivalents in International System (SI) units. Please note these conversions may be approximate but are in accordance with the Institute of Electrical and Electronic Engineers (IEEE)/American Society for Testing Materials (ASTM) SI 10-2002, *American National Standard for Use of the International Systems of Units (SI): The Modern Metric System.*

1.9 Applicable Documents

The following standards, test methods, and methodologies are referenced in this standard or will assist in better understanding the standard:

American Society of Civil Engineers (ASCE), Reston VA www.asce.org
ASCE7 – ASCE7-98; ASCE7-02; ASCE7-05; ASCE7-10

American Society for Testing and Materials (ASTM), West Conshohocken, PA. www.astm.org *ASTM SI 10-2002* American National Standard for Metric Practice

ICC Evaluation Service, a Subsidiary of the International Code Council®, Whittier, CA. www.icc-es.org

AC156: *Acceptance Criteria for Seismic Certification by Shake-Table Testing on Nonstructural Components,* Effective 11/1/10; editorially revised 2/12.

International Code Council, Washington D.C. www.iccsafe.org

2000 International Building Code®: Commentary for *Chapter 16 – Structural Design* and *Chapter 17*

Structural Tests and Special Inspections
2000, 2003, 2006 International Building Code® - 1708.5
2009, 2012 International Building Code® - 1708.4

Office of Statewide Health Planning & Development (OSHPD), Sacramento, CA
OSHPD Preapproval of Manufacturer's Certification (OPM)
OSHPD Special Seismic Certification Preapproval (OSP)

The VMC Group, Bloomingdale NJ www.thevmcgroup.com
"IBC® and OSHPD Implementation Methodology Overview®"
"Special Seismic Certification (VMA) Pre-Approval Procedures"

ISO 17065-17067

1.10 Definitions

For the purposes of this standard, the following definitions apply:

Active Equipment/Component
Equipment/component containing moving or rotating parts, electrical parts such as switches or relays, or other internal components that are sensitive to earthquake forces and critical to the function of the equipment.

Above Definition from 2013 California Building Code® Section 202

Appeal
The process for an applicant to apply to the Independent Certifying Body to reconsider or review a certification decision.

Applicant
The company that has applied for certification under the scheme.

Application
Applicant's completed request form for assessment and certification.

Approved Agency
An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved.

Above Definition from 2012 International Building Code® Section 202

Attachments
Means by which nonstructural components or supports of nonstructural components are secured or connected to the seismic force-resisting system of the structure. Such attachments include anchor bolts, welded connections, and mechanical fasteners.

Above Definition from ASCE7-10 Section 11.2

Audit
A process to gather objective evidence whether or not an applicant fulfills the certification requirements.

Audit Report
Information gathered by the Audit Team Leader following an assessment of an applicant's fulfillment of certification requirements.

Audit Team Leader
The auditor responsible for preparing and submitting the audit report.

Certificate of Conformance/Compliance
A certificate stating that materials and products meet specified standards or that work was done in compliance with approved construction documents.

Above Definition from 2012 International Building Code® Section 202

Certification
Certification under the scheme in accordance with the certification requirements.

Certification Body
Third-party conformance assessment body operating certification schemes.

NOTE: A certification body can be non-governmental or governmental (with or without regulatory authority).

Certification Requirement
Specified requirement, including product requirements, fulfilled by the customer as a condition of establishing or maintaining certification.

NOTE: Certification requirements include requirements imposed on the customer by the Certifying Body (usually via the certification agreement) to meet these procedures, and can also include requirements imposed on the customer by the certification scheme.

EXAMPLE: The following are certification requirements that are not product requirements.

- Completing the certification agreement
- Paying fees
- Providing information about changes to the certified product
- Providing access to certified products for surveillance activities

Certification Scheme
Certification system related to specified products, to which the same specified requirements, specific rules and procedures apply.

NOTE 1: The rules, procedures and management for implementing product and process certification are stipulated by the certification scheme.

NOTE 2: General guidance for the development of schemes is given in ISO/IEC 17067.

Certified
Attestation that a customer has fulfilled the requirements of the scheme.

Change History Log
A log that the manufacturer keeps of all design changes that occur to the original certified unit.

Conflict of Interest
Where a person or organization has one or more interests that may prevent that person or organization from acting in an impartial manner. Impartial is defined as a perceived or real presence of objectivity.

Consultancy
Participation in the designing, manufacturing, installing, maintaining or distributing of a certified product, process or service, or a product, process or service to be certified.

NOTE: In these procedures, the term "consultancy" is used in relation to activities of certification bodies, personnel of certification bodies and organizations related or linked to certification bodies.

Customer
Organization or person responsible to a certifying body for ensuring that certification requirements, including product requirements, are fulfilled.

NOTE: Whenever the term "customer" is used in these procedures, it applies to both the "applicant" and the "customer", unless otherwise specified.

Component
A part of an architectural, electrical, or mechanical system.

Above definition from ASCE7-10 Section 11.2

Component, Nonstructural
A part of an architectural, mechanical, or electrical system within or without a building or nonbuilding structure.

Above definition from ASCE7-10 Section 11.2

Design Earthquake Ground Motion
The earthquake ground motion that buildings and structures are specifically proportioned to resist in Section 1613.

Above Definition from 2012 International Building Code® Section 202

Designated Seismic System
Those nonstructural components that require design in accordance with Chapter 13 of ASCE7 and for which the component importance factor, Ip, is greater than 1 in accordance with Section 13.1.3 of ASCE7.

Above Definition from 2012 International Building Code® Section 202

Essential Facilities
Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquakes.

Above Definition from 2012 International Building Code® Section 202

Evaluation
Combination of the selection and determination functions of conformance assessment activities.

Impartiality
Presence of objectivity

NOTE 1: Objectivity is understood to mean that conflicts of interest do not exist, or are resolved so as not to adversely influence the activities of the body.

NOTE 2: Other terms that are useful in conveying the element of impartiality are independence, freedom from conflicts of interest, freedom from bias, freedom from prejudice, neutrality, fairness, open-mindedness, even-handedness, detachment and balance.

Independent Certifying Body (ICB)
An impartial third-party audit body contracted by the scheme owner to administer the scheme.

Independence
An approved agency shall be objective, competent and independent from the contractor responsible for the work being inspected. The agency shall also disclose possible conflicts of interest so that objectivity can be confirmed.

Above Definition from 2012 International Building Code® Section 1703A.1.1

Inspection Certificate
An identification applied on a product by an approved agency containing the name of the manufacturer, the function and performance characteristics, and the name and identification of an approved agency that indicates that the product or material has been inspected and evaluated by an approved agency (see Section 1703.5 and "Label" and "Mark").

Above Definition from 2012 International Building Code® Section 202

Inspection and Identification
The approved agency shall periodically perform an inspection, which shall be in-plant if necessary, of the product or material that is to be labeled. The inspection shall verify that the labeled product or material is representative of the product or material tested.

Above Definition from 2009 International Building Code® Section 1703A.5.2

Label
An identification applied on a product by the manufacturer that contains the name of the manufacturer, the function and performance characteristics of the product or material, and the name and identification of an approved agency, and that indicates that the representative sample of the product or material has been tested and evaluated by an approved agency (see Section 1703.5 and "Inspection Certificate" and "Mark").

Above Definition from 2012 International Building Code® Section 202

Label Information
The label shall contain the manufacturer's or distributor's identification, model number, serial number or definitive information describing the product or material's performance characteristics and identify the approving agency.

Above Definition from 2009 International Building Code® Section 1703A.5.3

Labeled
Equipment, materials or products to which has been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above-labeled items and whose labeling indicates either that the equipment, material or product meets identified standards or has been tested and found suitable for a specified purpose.

Above Definition from 2012 International Building Code® Section 202

Labeling
Where materials or assemblies are required by this code to be labeled, such materials and assemblies shall be labeled by an approved agency in accordance with Section 1703A. Products and materials required to be labeled shall be labeled in accordance with the procedures set forth in Sections 1703A.5.1 through 1703A.5.4.

Above Definition from 2009 International Building Code® Section 1703A.5

Major Nonconformance
An audit finding which is indicative of a system deficiency that puts at risk product quality or service. It must be rectified within a defined time period. A major nonconformance is also the absence of a required procedure or the total breakdown of a system, process or procedure.

Mark
An identification applied on a product by the manufacturer indicating the name of the manufacturer and the function of a product or material (see also "Inspection Certificate" and "Label").

Above Definition from 2012 International Building Code® Section 202

Method of Labeling
Information required to be permanently identified on the product shall be acid etched, sand blasted, ceramic fired, laser etched, embossed or of a type that, once applied, cannot be removed without being destroyed.

Above Definition from 2009 International Building Code® Section1703A.5.4

Minor Nonconformance
An audit noncompliance finding which is indicative of a system deficiency but poses no immediate hazard to a system, process, product quality or customer satisfaction. It must however be rectified within a defined time limit. A minor nonconformance is also a single observed lapse in a system, process or procedure.

NOTE: A number of minor nonconformance's given toward a single audit area may cause consideration for a major nonconformance.

Observer
An employee of The VMC Group Engineering Services Division or other organization that observes the certification process and audit activities.

Periodic Special Inspection
Special inspection by the special inspector who is intermittently present where the work to be inspected has been or is being performed.

Above Definition from 2012 International Building Code® Section 202

Periodic Special Inspection
The part-time or intermittent observation of work requiring special inspection by a special inspector who is present in the area where the work has been or is being performed and at the completion of the work.

Above Definition from 2009 International Building Code® Section 1702

Product
Result of a process. Examples: air handling unit, genset, motion control drive.

Product Certification Agency (PCA)
An agency that has met the requirements of AC370, and has been approved by International Accreditation Services (IAS).

Process
A set of interrelated or interacting activities that transforms inputs into outputs.

Product Requirement
Requirement that relates directly to a product, specified in standards or in other normative documents identified by the certification scheme.

NOTE: Product requirements can be specified in normative documents such as regulations, standards and technical specifications.

Registered Design Professional in Responsible Charge
A registered design professional engaged by the owner to review and coordinate certain aspects of the project, as determined by the building official, for compatibility with the design of the building or structure, including submittal documents prepared by others, deferred submittal documents and phased submittal documents.

Above Definition from 2012 International Building Code® Section 202

Rugged Equipment
Rugged equipment refers to an ampleness of construction that gives such equipment the ability to survive earthquake strong motions without significant loss of function.

Above Definition from 2013 California Building Code® Section 202

Scheme Owner (The VMC Group)
Person or organization responsible for developing and maintaining a specific certification scheme.

NOTE: The scheme owner can be the Certification Body itself, a governmental authority, a trade association, a group of certification bodies or others.

Scope of Certification
Identification of

- The product(s), process/s or service/s for which the certification is granted.
- The applicable certification scheme.
- The standard(s) and other normative document(s), including their date of publication, to which it is judged that the product(s), process/s or service/s comply.

Seismic Capacity
Defined as the capacity associated with the component's internal structure and its attachments, to resist seismically induced forces and deformations, and maintain structural integrity. Post-test functionality shall be maintained for components with Ip = 1.5.

Above Definition from Acceptance Criteria AC156 (2012) Section 3.14

Seismic Design Category
A classification assigned to a structure based on its risk category and the severity of the design earthquake ground motion at the site.

Above Definition from 2012 International Building Code® Section 202

Service
Result of at least one activity necessarily performed at the interface between the supplier and the customer.

Significant Loss of Function
Significant loss of function for equipment or components means the equipment or component cannot be restored to its original function by competent technicians after a design earthquake because the equipment or component require parts that are not normally stocked by the owner or not readily available.

Above Definition from 2013 California Building Code® Section 202

Special Inspection 2012
Inspection of construction requiring the expertise of an approved special inspector in order to ensure compliance with this code and the approved construction documents.

Above Definition from 2012 International Building Code® Section 202

Special Inspection 2013
Special inspection by the special inspector who is present when and where the work to be inspected is being performed.

Above Definition from 2013 California Building Code® Section 202

Special Inspection, Continuous
The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.

Above Definition from 2009 International Building Code® Section 1702

Symbol
The unique identification granted by the ICB to the customer that identifies the customer's product as certified. This is known as the VMA Number, and is indicated on the label applied to the customer's certified product.

Special Inspection for Special Seismic Certification
The special inspector shall examine equipment and components requiring Special Seismic Certification in accordance with Section 1705A.12.4 and verify that the label, anchorage or mounting conforms to the Certificate of Compliance.

Above Definition from 2013 California Building Code® Section 1705A.11.4

Special Seismic Certification
The process by which manufacturers have the active/energized equipment certified for installation as a Designated Seismic System.

The 2013 California Building Code® Section 1705A.12.4 describes it as such:

> The registered design professional shall specify on the construction documents the requirements for Special Seismic Certification by analysis, testing or experience data for equipment and components listed in Section 1705A.12.4.1. Active or energized equipment and components shall be certified exclusively on the basis of approved shake table testing in accordance with ICC-ES AC156. A minimum of two equipment/components shall be tested for a product line with similar structural configuration. Where a range of products is tested, the two equipment/components shall be either the largest and smallest, or an approved alternative representative sampling of the equipment/components.
>
> **Exception:**
> When a single product (and not a product line with more than one product with variations) is certified and the manufacturing process is ISO 9001 certified, one test shall be permitted. All tests shall be performed by an independent laboratory having accreditation to the International Standards Organization (ISO) accreditation standard 17025 or shall be under the responsible charge of an independently licensed engineer. Test reports shall be reviewed and accepted by an independent California licensed structural engineer. For a multi-component system, where active or energized components are certified by tests, connecting elements, attachments, and supports can be justified by supporting analysis.
>
> 1705A.12.4.1 Special Seismic Certification shall be required for the following systems, equipment, and components:
>
> 1. Emergency and standby power systems.
> 2. Elevator equipment (excluding elevator cabs).
> 3. Components with hazardous contents.
> 4. Exhaust and smoke control fans.
> 5. Switchgear and switchboards.
> 6. Motor control centers.
> 7. Radiography and fluoroscopy systems in fluoroscopy rooms.

8. CT (Computerized Tomography) systems.
9. Air conditioning units.
10. Air handling units.
11. Chillers, evaporators, and condensers.
12. Cooling Towers.
13. Transformers.
14. Electrical substations.
15. UPS and batteries.
16. Distribution panels.
17. Control panels.
18. Power isolation and correction systems.
19. Motorized surgical lighting systems.
20. Motorized operating table systems

Exceptions:

1. Equipment and components weighing not more than 20 lbs. supported directly on structures (and not mounted on other equipment or components) with supports and attachments in accordance with this code.

2. Movable (mobile) and temporary equipment/components, which are not anchored to structure or permanently attached to the building utility services such as electricity, gas, or water. For the purposes of this requirement, "permanently attached" shall include all electrical connections except plugs for duplex receptacles.

3. Pipes, ducts, conduits, and cable trays, excluding inline equipment and components.

4. Underground tanks.

5. Electric motors and pumps not more than 10 hp. rigidly supported directly on structures (and not mounted on other equipment or components) with supports and attachments in accordance with this code.

Special Certification Requirements for Designated Seismic System Certifications shall be provided for Designated Seismic Systems assigned to Seismic Design Categories C through F as follows:

1. Active mechanical and electrical equipment that must remain operable following the design earthquake ground motion shall be certified by the manufacturer as operable whereby active parts or energized components shall be certified exclusively on the basis of approved shake table testing in accordance with Section 13.2.5 or experience data in accordance with Section 13.2.6, unless it can be shown that the component is inherently rugged by comparison with similar seismically qualified components. Evidence demonstrating compliance with this requirement shall be submitted for approval to the authority having jurisdiction after review and acceptance by a registered design professional. Components with hazardous substances and assigned a component importance factor, Ip, of 1.5 in accordance with Section 13.1.3 shall be certified by the manufacturer as maintaining containment following the design earthquake ground motion by (1) analysis,

(2) approved shake table testing in accordance with Section 13.2.5, or (3) experience data in accordance with Section 13.2.6. Evidence demonstrating compliance with this requirement shall be submitted for approval to the authority having jurisdiction after review and acceptance by a registered design professional.

Subassemblies
A grouping or assemblage of subcomponents and/or structural elements that require attachment to the component's primary force resisting system to achieve structural stability.

Above Definition from Acceptance Criteria AC156 (2012) Section 3.13

Supports
Those members, assemblies of members, or manufactured elements, including braces, frames, legs, lugs, snubbers, hangers, saddles, or struts, and associated fasteners that transmit loads between nonstructural components and their attachment to structure.

Above Definition from ASCE7-10 Section 11.2

Testing
An approved agency shall test a representative sample of the product or material being labeled to the relevant standard or standards. The approved agency shall maintain a record of the tests performed. The record shall provide sufficient detail to verify compliance with the test standard.

Above Definition from 2013 California Building Code® Section 1703A.5.1

Unit Under Test (UUT)
The component item to be certification-tested.

Above Definition from Acceptance Criteria AC156 (2012) Section 3.19

VMA Approval Certification Marks
The VMA Approval Certification Marks are detailed in **Appendix B**. Their use is mandatory without change on all Approved VMA products. These registered marks cannot be used except as authorized by The VMC Group via the granting and maintaining of approval for a specific product component.

2. GENERAL INFORMATION

2.1 Product Listing

All nonstructural components can be categorized by industry and function. The primary categories are power, HVAC, medical, and control systems. The categories help divide up functionality requirements, certification matrix creation, and design break methodologies.

I Power	1. Emergency and standby power 2. UPS and inverters 3. ATS/switchgear/switchboards 4. Motor control centers 5. Transformers 6. Electrical substations 7. Power isolation and correction 8. Grounding systems 9. Distribution panels 10. Electrical busways
II HVAC	1. Air conditioning/handling units 2. Heaters/heat pumps 3. Chillers (air and water-cooled) 4. Cooling towers 5. Exhaust/smoke control fans 6. Water pumps/fire pumps 7. VAV boxes/air terminal units 8. Boilers/water heaters
III Medical	1. Radiography and fluoroscopy 2. CT systems 3. Nurse call systems 4. Operating table systems 5. Surgical lights
IV Control	1. Control panels 2. Internal servers and routers 3. Variable frequency drives 4. Fire and smoke alarm systems

Table 2.1-1: Nonstructural Mechanical and Electrical Product Categories

The above list is a general guideline and also includes other nonstructural components deemed necessary for the continued operation of an essential facility.

When interpolating or extrapolating a product line, there are many aspects that need to be investigated to minimize the number of specimens required for full certification. In general, the main aspects are production facility/manufacturer/model series, structural features, mounting options, subassemblies, and configuration variation.

2.1.1 Facility, Manufacturer, Model Series

Each manufacturing facility, which creates a specific model series, must have either ISO 9001:20XX certification or a minimum of (2) units from that product series must be tested from the plant. Differences in quality control within the same manufacturer having different facilities must be accounted for in the minimum statistical sense.

2.1.2 Structural Features (AC156 §4.5.1, §4.5.4, IEEE344 §9.3.3, §11.3.3)

Design breaks must account for all changes in force resistance. A useful tool in the evaluations of large product lines and subcomponents is to use generic ratio terms to compare similarly attached elements.

$$\boldsymbol{H}_i = m_i a_i \left(\frac{h_i}{d_i w_i}\right)\left(\frac{\sigma_i}{n_i}\right)$$

Equation 2.1.2-1: Design Comparison

Where 'H' is the comparative factor, 'm' is the mass, 'a' is the acceleration, 'h' is the height, 'd' is the depth, and 'w' is the width, 'σ' is the acceptable material strength, and 'n' is the number of equally distributed restraints. This type of equation would be useful for initial design breaks and makes many assumptions.

Distribution of mass in a product must be justified as to provide the least seismic capacity to the test specimen. If worse mass distribution conditions exist, it must be shown that either the material strength or anchor reactions constitute more dramatic reduction in seismic capacity.

2.1.3 Mounting Options (AC156 §4.5.2)

Different mounting types must be accounted for in the certification matrix. The location and type being tested must be shown to provide the least seismic capacity. Welded, bolted, spring isolated, rubber isolated, and other fundamentally different mounting types should be analyzed with appropriate amplification and reduction factors in ASCE7 §13.4 (nonstructural component anchorage). An example of an appropriate anchorage reaction force calculation is shown below for an assumed rigid body with generalized anchorage locations.

$$\boldsymbol{F}_i = -K\Delta\boldsymbol{r}_i$$

$$\boldsymbol{R}(\boldsymbol{\omega},\theta) = \boldsymbol{I} + \boldsymbol{\omega}\sin\theta + \boldsymbol{\omega}^2(1-\cos\theta)$$

$$\boldsymbol{M} = \sum \boldsymbol{r}_i \times -K[\boldsymbol{r}_i - \boldsymbol{r}_i\boldsymbol{R}(\boldsymbol{\omega},\theta)] - \boldsymbol{r}_{cg} \times \boldsymbol{F}_{Body} = 0$$

$$K\theta \begin{bmatrix} I_{yy}+I_{zz} & -I_{xy} & -I_{xz} \\ -I_{xy} & I_{xx}+I_{zz} & -I_{yz} \\ -I_{xz} & -I_{yz} & I_{xx}+I_{yy} \end{bmatrix} \boldsymbol{\omega} - \boldsymbol{r}_{cg} \times \boldsymbol{F}_{Body} = 0$$

$$\boldsymbol{F}_i = -K\theta \begin{bmatrix} 0 & z_i & -y_i \\ -z_i & 0 & x_i \\ y_i & -x_i & 0 \end{bmatrix} \boldsymbol{\omega}$$

Equation 2.1.3-1: Rigid Body Overturning Anchorage Reaction Calculation

Where 'F' is force at each restraint, 'K' is the linear-elastic force proportionality, 'r' is the distance to a restraint, 'R' is the rotation matrix in the form of a unit length axis 'ω' and rotation angle 'θ', 'M' is the moment on the body and 'I' is the second moment of area. Assumes a rigid body, small deflection (can be done by simply making K large), and general restraints.

Particular attention should be made for bolt clearance size, effective weld length/expected penetration depth, and other parameters for the specific attachment. In general, any parameters which may change the dynamic response of that joint must be identified. Vibration isolation device should have effective gap size denoted to help predict impact loading.

Fasteners

Fasteners such as bolts, screws, nails, and rivets must be identified by several specific parameters to denote the approved strength, application, and reliability. Each fastener type should be denoted by an ICC-ES seismic rating and should include the diameter, pitch, and screw length. Other parameters, which effect dynamic response, shall be listed such as clearance size, placement exceptions and alternatives and angle of attachment.

2.1.3.1 Welds

Welds of all types should list basic parameters such as weld size, stitch lengths, penetration depth, specific material selections, inspection criteria, and expected theoretical strength.

2.1.3.2 Vibration Isolators

Isolators that are designed for standard operating vibration damping must be identified with several specific parameters. The model series, designation as captive or non-captive, small deflection load curve with effective air-gap value, installation instructions, and its certification involvement, is to be maintained by VMA 1826 §2.1.4. Its connection from the equipment and to the final anchor shall be rationalized through VMA 1826 §2.1.3.

2.1.3.3 Seismically Restrained Vibration Isolators

Isolators which are designed for seismic restraint must be identified with the same parameters set forth in VMA 1826 §2.1.3 with the addition of an expanded load curve and cyclic loading parameters.

2.1.4 Subassemblies (AC156 §4.5.3)

Subassemblies must adhere to the same requirements specified in VMA 1826 §2.1 as if it was its own product unless the parent product it is attached to has a specific model number, which captures the subcomponent adequately.

2.1.5 Configuration Variations (AC156 §4.5.5, IEEE344 §9.5)

Configuration variations such as modular sections should be considered as primary structural differences because of their vastly different dynamic response characteristics. There are several ways to address modular product lines to minimize the number of test specimens.

2.2 Approval Application Requirements

2.2.1 Process

The process of obtaining seismic certification begins with filling out the application referenced in VMA 1826 §2.2.2 and ends with the two packages of attached documents. After all information is submitted, there is a review period, question and answer period, then final acceptance, which includes public posting on the website.

Application Fee	USD $5000
Review Period	<4 Weeks
Certification Duration	3 Years
Audit(s) Included	1

Table 2.2.1-1: Application Fee and Review Period

2.2.1.1 Application Fee

Each VMA Number issued for a project will require individual application fees. This is necessary to scale the review time with the size of a certification matrix.

2.2.2 Application Submission Document

To begin the process of IBC® nonstructural component certification, fill out the application located at www.ibcapproval.com/Approval-Application and send all documents electronically to info@IBCapproval.com. Additional instructions are provided on the application document.

There should be two groups of documents sent as separate packages. The first package would include attachments that will be posted on The VMC Group VMA Certification Website. The second package contains remaining documents which are required for review, but that will not be posted on the website.

The VMA Certification Application requires the following information:

A. Application Type
   A.1. Application Reference
      A.1.1. VMA Number
   A.2. Type
      A.2.1. New
      A.2.2. Renewal
B. Manufacturer Information
   B.1. Manufacturer
   B.2. Manufacturer's Technical Representative
   B.3. Mailing Address
   B.4. Telephone
   B.5. Email
C. Product Information
   C.1. Product Name
   C.2. Product Type
D. Applicant Information
   D.1. Applicant Company Name
   D.2. Contact Person
   D.3. Mailing Address
   D.4. Telephone
   D.5. Email
   D.6. Signature of Applicant
   D.7. Date
   D.8. Title
   D.9. Company Name
E. United States Licensed Structural Engineer Responsible for Engineering and Test Report(s)
   E.1. Company Name
   E.2. Name
   E.3. State and License Number
   E.4. Mailing Address
   E.5. Telephone
   E.6. Email
F. Certification Standard
   F.1. ICC-ES AC156
   F.2. IEEE 344-2004
   F.3. Other
G. Testing Laboratory
   G.1. Contact Name
   G.2. Mailing Address
   G.3. Telephone
   G.4. Email
H. Seismic Parameters
   H.1. Accordance with ASCE7-10 Chapter 13
   H.2. Design Basis of Equipment (Fp/Wp)
      H.2.1. S_{DS} (Design Spectral Response Acceleration at Short Period, g)
      H.2.2. A_p (Equipment Amplification Factor)
      H.2.3. R_p (Response Modification Factor)
      H.2.4. I_p (Importance Factor)

H.2.5. z/h (Height Factor Ratio)
H.2.6. Ω_0 (Over Strength Factor)
H.2.7. Lowest Component Natural Frequencies (Hz)
H.2.8. Overall Dimensions and Weight
H.3. Tank(s) Designed in Accordance with ASME BPVC, 2010

I. List of Attachments Supporting Special Seismic Certification
I.1. Test Report(s)
I.2. Drawings
I.3. Calculations
I.4. Manufacturer's Catalog
I.5. Other(s)

J. VMC Approval Signatures
J.1. Expiration Date
J.2. Signature
J.3. Date
J.4. Print Name
J.5. Title
J.6. Special Certification Valid Values
J.6.1. S_{DS} Range
J.6.2. z/h Range
J.7. Condition of Approval

Table 2.2.2-1, IBC® Certification Application.

2.2.3 Public Information/Package I

2.2.3.1 List of Equipment/Components Certified

Each piece of equipment or component which is being certified must have identification numbers (model numbers or part numbers), size ranges (length, width and height ranges), weight ranges, S_{DS} levels, z/h range, and a list of all major sub-assemblies and sub-components to be certified when required by AC156 §5.2.2.1.

2.2.3.2 Description of Unit(s) Under Test

Each Unit Under Test (UUT) that is in accordance with AC156 §5.2.2.1 must have a detailed description of the UUT including the UUT configuration, listing of major sub-assemblies and sub-components, and any other applicable product differentiation, description of mounting method and configuration, photograph of the component set-up on the shake table, shake table test seismic parameters, lowest resonant frequencies in three orthogonal directions, statement to verify that the units were full of contents during tests (operating weight must be reached), statement to verify that the units maintained structural integrity and functionality after the seismic event.

2.2.4 Private Information/Package II

2.2.4.1 Test Report(s)

See Section 4.1.2.4

2.2.4.2 Interpolation/Extrapolation Justification

Justification of the interpolation or extrapolation in a product line from Units Under Test must be supported by a manufacturer's catalog and/or schematic cut sheets.

2.2.4.3 Sub-Assembly/Sub-Component Reduction Justification

If a listing of major sub-assemblies or sub-components is not required by AC156 §5.2.2.1, a certification by the manufacturer that explicitly addresses all four items listed below shall be included:

2.2.4.3.1 Uniqueness of Part Numbers

Part numbers for the unit or system uniquely identifying the configuration, manufacturers, and materials of the sub-components within the unit or system (The part number uniquely identifies the unit or system).

2.2.4.3.2 UUT Similar Sub-Component Manufacturer and Materials

Sub-component manufacturers and materials within the two tested units used for interpolation are the same (Using ASTM standards or equivalent).

2.2.4.3.3 UUT to Product Line Sub-Component Similarity

Sub-component manufacturers and materials within the interpolated units are the same as the two tested units used for interpolation.

2.2.4.3.4 UUT to Product Line Configuration Similarity

Configuration of the interpolated units is similar to the two tested units used for interpolation.

2.2.5 Triage Review

Before the detailed review is complete, a collection of general triage comments will be sent to the submission representative to address the noted comments.

2.2.5.1 Review Period

The primary review duration is defined in VMA 1826 §2.2.1 and does not include additional review time for responses to triage comments or additional revisions, which are typically less than 1 week each depending on the size of the update.

2.2.5.2 Question Response

Responses should be given in a concise format usually by setting up a question and answer where each is addressed separately with all attachments referenced in the response section of each question.

2.2.6 Public Certification Posting

All certifications will be labeled as "Pending" as soon as the first package described in VMA 1826 §2.2.3 is submitted with a completed application and its associated application fee. After the final review and all triage comments are addressed, the certification will be updated to reflect the expiration date based on VMA 1826 §2.2.1. The website will also have a direct link to the up-to-date Certificate of Compliance (C of C).

2.2.6.1 Certificate of Compliance

The Certificate of Compliance is issued after the acceptance of certification and posting on the listing website and contains general limitations of the seismic certification, as well as simplified product offering descriptions for use in industry applications.

A typical C of C shall include written certification from the manufacturer that the materials and products meet the specified standards of the agency responsible for the testing and certification of the product. This information is not made public. The C of C shall include all of the product models and variations that are covered under the certification as well as the major subcomponents that are offered. The maximum seismic design load (S_{DS}) and the height ratio (z/h) shall be displayed clearly for all products listed on the Certificate of Compliance. All information on the C of C shall match the label as described in § 3.3.

2.3 Responsibilities For Units To Be Tested

2.3.1 Responsibilities of Manufacturers

The manufacturer is responsible for producing and shipping the UUTs for testing from the specific factory or factories that are requesting certification to and from the test lab site. The manufacturer or applicant shall provide competent, experienced support personnel for receiving, packing, assembling and installation of equipment. The manufacturer shall have competent and experienced personnel on site during the test to assist with all phases of the test plan including but not limited to pre and post testing requirements.

See VMA 1826 §1.5 Maintaining Certification for additional information about the maintenance program.

See VMA 1826 §5.1 Production Tests & Internal Audit by the Manufacturer & 5.2 for additional information about the audit program.

See VMA 1826 §1.5.2 Nullification Circumstances for reasons for nullification of the certification.

2.3.2 Responsibilities of Certification Agencies

The certification agency is responsible to submit all documents required in VMA 1826 §2.2.2, §2.2.3 and §2.2.4 to the listing agency for review.

3. GENERAL REQUIREMENTS

3.1 Review of Documentation

Documentation review in some form must occur at every point throughout the duration of the project.

3.1.1 Required Technical Information

To begin any engineering analysis, there are several minimum requirements to allow a professional engineer to begin an adequate analysis of any complex system. Bills of material, material specifications and quality information, assembly drawings, and installation manuals must be disclosed to the engineering team responsible for the tested equipment. This information must be given to the project engineer as to allow proper confidence analysis which is required for lab safety and equipment risk mitigation. Most of this information is to remain confidential between the manufacturer and the certifying agency.

See VMA 1826 §1.4 for additional information.

3.1.2 Quality Assurance

A quality assurance program must be in place, whereby all revisions to the product line which is seismically certified, must pass an additional procedure of notification to the listing agency and a hold for on-site operational dependency until it is approved for seismic installation. A label is not allowed on the equipment until any and all discrepancies with the original certified design are justified.

See VMA1826 §5 for details of how a maintenance program works.

3.2 Customer Testing Responsibilities

Including those listed in VMA1826 §2.3.1, there are specific requirements called out in "IBC® and OSHPD Implementation Methodology Overview®".

3.3 Markings

3.3.1 Label

In all seismic design projects, the components that have an importance factor of 1.5 require a label as described in section IBC® §1703.5, the audit procedure, VMA1826 §5.2 and is also reiterated in ASCE7 §11A.2.6.

The label must be affixed to the product by the manufacturer and in essence references what is certified, what the capacity and performance during seismic testing was, and what approval agency is responsible for the certification.

IBC® §1703.5 contains information on what is required for the label itself and about the audit process cycle.

3.4 Manufacturer Installation Instructions

Installation manuals shipped with seismically certified products must have special instructions if the attachment configuration deviates from standard listings. Any and all special attention to adjustment of vibration isolators, pipe clearances, and equipment-to-building connections must be reiterated as to provide another at-installation check of code requirements. A listing of requirements of a site-condition specific anchoring package is necessary to ensure proper installation in compliance with the equipment's certification.

All documents should be distributed in a minimum format of English language and SI units.

4. PERFORMANCE REQUIREMENTS

4.1 Shake Table Testing

The purpose of shake table testing is to provide experimental proof that a specific unit under test (UUT) can structurally and functionally withstand a realistic seismic event and operate as intended afterward if required by its importance factor.

The primary standard used for shake table testing is ICC-ES AC156. Seismic shake testing done in accordance with AC156 has many requirements. The most important requirements are elaborated upon in this section. Before a shake test may be conducted, the units under test must be identified and the target seismic level must be defined. During the shake test, specific data acquisition requirements must be met to achieve minimum seismic capacity.

4.1.1 Shake Test Preparation

Preparation for seismic shake testing can be broken down into three (3) primary tasks: Confidence analysis, fixturing, and creation of the test plan document. The confidence analysis provides a quantification of risk associated with a specific seismic spectrum target. The confidence analysis may result in a lowering of the target spectrum or design modifications to strengthen the test specimen to withstand the seismic accelerations.

4.1.1.1 Confidence Analysis

An analysis to determine the likelihood that the primary structure will withstand the seismic event must be completed and a statement as such must be generated and given to the manufacturer and a copy to the testing laboratory. A complete confidence analysis for each subcomponent can yield significant cost savings as to avoid re-shakes while at a laboratory.

4.1.1.2 Fixturing

Fixturing involves the design, production, and implementation of adapting the UUT to the shake table's allowable connections. Most shake tables offer pre-defined spacing of attachment locations and require fixtures to be designed appropriately.

All fixtures must possess a loaded lowest natural frequency above 16.67 Hz as specified by the "Rigid" definition in AC156 §3.12 so as to not contribute significantly to the reduction or amplification of table excitation.

4.1.1.3 Test Plan Document

The Test Plan document must be generated so as to communicate precisely the spectral requirements for each UUT to the test laboratory. There are many requirements to such a document that includes the following:

- Document reference number (specific to the test plan) on all pages.
- Page numbers in form (page X of Y) on all pages.
- Certification Agency description including headquarters and contact.
- Manufacturer description including headquarters and contact.
- Table of contents.
- Release validation (signatures of release for use).
- Revision history (signatures and change summary).
- Engineer of record (must have PE license).
- Testing standard and revision in compliance.
- Scope of responsibilities of all parties involved in laboratory testing
- Test names of each UUT (to be used on test labels).
- Description of UUTs (dimensions, weights, industry-used size).

- Mounting of UUTs (anchor type/size/count, installation orientation).
- Instrumentation locations (list required sensitivity and limits, global names).
- Full description of spectral requirements (seismic standard specific).
- General procedure to be implemented (seismic standard specific).
- Fixture drawings, overlay with UUTs.
- Submittal drawings of each UUT and its configuration.
- Any and all vibration or seismic isolators with installation information.
- Test schedule, which denotes arrival, seismic test, and ship-out dates.

4.1.2 Laboratory Procedure

The general laboratory procedure below must be followed by the certifying agency to obtain legitimate certification of any UUT. Failure to comply with any requirement will lead to additional complications in validation of the testing or complete nullification of the test events.

4.1.2.1 Primary Inspection

All UUTs in any particular configuration that are to be shake tested, must undergo a shipping quality inspection, matrix slot identification, and pre-shake functionality test. These programs ensure that a structurally and functionally optimal test specimen is being shaken.

4.1.2.1.1 Shipping Quality Inspection

All UUTs that arrive on-site by any substantial means of transportation must go through a witnessed shipping inspection. This process must include documentation of the shipping company, arrival date and time and apparent damage summary sent directly to the originator.

Any and all shipping damage must be reported immediately from the laboratory within 1 business day to the manufacturer. Shipping damage must be identified as circumstantial or systemic. Pictures must be taken in accordance with VMA § Section 4.1.2.4.

If the shipping damage is systemic, the process must be reviewed internally by the manufacturer under their quality control system and a copy of the report and results must be supplied to the laboratory for its final report.

4.1.2.1.2 Matrix Slot Identification

The position each UUT is given in a certification matrix enables interpolation and extrapolation to be justified. Any deviations

from the dimensions, weight, capacity, electrical characteristics, subcomponent details, or other identified descriptions in the certification matrix must be explained. All implications of deviations must immediately be disclosed to the manufacturer.

4.1.2.1.2.1 Test Labeling

After the UUT has been cleared both for superficial shipping damage and correct matrix position, a label may be attached. The label must include a reference to the test plan document and name of the UUT as used in the test plan.

See Sample Testing label in Appendix C.

These UUT labels correlate media as pictures and videos with test specimens if otherwise not denoted. A nameplate on the UUT is not adequate to completely define the specimen.

4.1.2.1.2.2 Subcomponent Validation

Each subcomponent listed on a certification matrix must be verified as being included in the test specimen. Any differences in the manufacturer, material, model number, or configuration of subcomponents must be immediately communicated to the manufacturer and certification agent to identify any implications on the interpolation and extrapolation. All deviations from the certification matrix must be clearly documented by on-site laboratory and certification agency staff.

4.1.2.1.3 Pre-Shake Functionality Requirements

Functionality of equipment must be proven before the seismic event to ensure a baseline performance measure. In addition to providing risk mitigation for loss of certification progress, pre-shake functionality tests allow for validation of shipping damage superficial effects and subcomponent systems.

Functionality of equipment is determined by reduction of factory quality control testing to reasonable time constraints. The following lists the most generic types of verifiable functionality parameters.

- Force-Resisting Structures constrained to structural integrity.
- Vibration or Seismic Isolators constrained to structural integrity.
- Vibrations constrained to deflection per frequency or decibels noise.

- Electrical Voltage constrained to minimum and maximum.
- Electrical Continuity constrained to resistance maximum.
- Electrical Insulation constrained to resistance minimum.
- Electrical Motors constrained to minimum operating performance.
- Electrical Controllers constrained to signal identification and creation.
- Power Generation constrained to load and time.
- Temperature constrained to temperature minimum or maximum.
- Actuators constrained to work through full range of motion.
- Fluid Vessels constrained to leakage quantity or pressure limitations.
- User Interfaces constrained to function and warning explanation.
- Debris constrained to non-interfering rest position.

4.1.2.2 Natural Frequency Search

The natural frequency search as defined by AC156 §6.4.5 is described in terms of a logarithmically changing frequency of excitation acceleration from 1.3 to 33.3 Hz with an amplitude suggested between 0.05g and 0.15g. Three (3) orthogonal directions must be tested for natural frequency response data and the locations of the accelerometers must be precisely determined to acquire the lowest natural frequency with the largest mass participation.

The sweep cannot be traversed faster than two (2) octaves per minute which leads to the following minimum sweep time equation:

$$a(t) = a_0 \sin 2\pi f_0 2^{\left(\frac{dn}{dt}\right)t}$$

$$T(f) = \frac{1}{\left(\frac{dn}{dt}\right)} \frac{\ln \frac{f}{f_0}}{\ln 2}$$

Equation 4.1.2.2-1: Natural Frequency Acceleration Control

Where 'a(t)' is the acceleration at time 't', 'a_0' is the constant acceleration amplitude, 'dn/dt' is the change in octaves per unit time, 'f_0' is the initial frequency, and 'T(f)' is the total time at frequency 'f'.

4.1.2.2.1 Accelerometer Placement

Accelerometers must be located on equipment to capture lowest natural frequencies that contain the greatest mass participation. Different types of equipment shall require different locations. The following lists some basic setups for three (3) axis accelerometers on different test equipment.

Global Location Rules:

- Massive subcomponents with > 30% of the total mass.
- Vibration isolated subcomponents with >10% of the total mass.
- Fixture interface near UUT connection.
- Shake table interface near fixture connection.

Local Location Rules:

- Do not place on diaphragm centers.
- Do not place on secondary stiffness members.
- Do not place on members that can only take tension.
- Do not place on members that can only take compression.

4.1.2.2.2 Test Verification

Verification of natural frequency test data happens before the seismic event occurs. Failure to obtain initial system dynamic response prediction can result in substantial risk during the seismic event.

The primary test verification for resonant frequency searches involves evaluating the time domain and frequency domain

4.1.2.2.2.1 Time Domain Validity Check

To confirm validity of the frequency domain content, a simple time domain check must occur. This involves looking at both the shake table feedback accelerometer data as a function of time synced with the subcomponent response accelerometer. Both of these graphs should be scaled linearly so as to efficiently detect anomalies.

The time history of both the input and output accelerometers should be relatively continuous. The sinusoidal shake should be obvious at the start when it is at around 1.3 Hz and should continue with almost constant target acceleration on the shake table top input accelerometer.

4.1.2.2.2.2 Frequency Domain Validity Check

The next check is that each Fourier transformed domain individually for shake table top accelerometer and the subcomponent have non-zero response at all frequencies. If the input (shake table top accelerometer) has a zero at any frequency, the transfer function will go to infinity and be invalid.

4.1.2.2.2.3 Frequency Domain Transfer Function

Natural frequencies are to be defined as having a minimum of 2.5x amplification (in 0.1g magnitude frequency sweeps) and have any phase shift against shake table excitation.

Each global lowest natural frequency should be identified and recorded before the seismic event.

Particular attention should be paid to the magnitude of the shake table input excitation during the natural frequency sweeps as they are often overlooked and can contribute significant fatigue energy into typical systems.

4.1.2.3 Seismic Event

The seismic event is defined by parameters that describe the frequency content of a non-stationary random broad-band acceleration controlled signal. Below we have a description in a more general mathematical description divided between required horizontal and vertical accelerations.

Parameter	Constraints	
$A_{Flex}^{Horz} = S_{DS}\left(1 + 2\frac{z}{h}\right)$	$\left(1 + 2\frac{z}{h}\right) \leq 1.6$	AC156
	$S_{DS} \leq 2.0$ (z/h = 1.0, only)	ASCE7 3rd Printing
$A_{Rig}^{Horz} = 0.4S_{DS}\left(1 + 2\frac{z}{h}\right)$	$S_{DS} \leq 2.0$ (z/h = 1.0 only)	ASCE7 3rd Printing
$A_{Flex}^{Vert} = \frac{2}{3}S_{DS}$	None	
$A_{Rig}^{Vert} = 0.4\frac{2}{3}S_{DS}$	None	

Table 4.1.2.3-1: Seismic Parameters

Where 'S_{DS}' is the short duration spectral acceleration and 'z/h' is the ratio height of the component to the average maximum height of the building.

Spectral Shape Function	*i*	f_i	a_i	Domain
$a(f) = a_i \left(\frac{f}{f_i}\right)^{\left[\frac{ln\left(\frac{a_{i+1}}{a_i}\right)}{ln\left(\frac{f_{i+1}}{f_i}\right)}\right]} \quad f_i \le f \le f_{i+1}$	0	0.1	$A_{Flex}/10$	Start of Empirical
	1	1.3	A_{Flex}	Start of AC156
	2	8.3	A_{Flex}	
	3	33.3	A_{rig}	End of AC156
	4	50	A_{rig}	End of Empirical

Table 4.1.2.3-2: Spectral Shape Function

4.1.2.3.1 Sensor Placement

Sensors such as accelerometers shall be used to obtain required information to be used in the certification requirements for the equipment. Code requirements include obtaining the lowest natural frequency of the tested component, and actual spectral input to the equipment. Additionally, displacement potentiometers can be used to obtain deflection at utility interfaces. For example, a displacement found to be X" at the top of a coil header would require a flexible connector to adapt it to a rigid building wall and even more if connected to another piece of equipment with a different maximum connection-point displacement. More information about these requirements can be found in ASCE7 §13.3.2.1 and specifically ASCE7 Equation 13.3-8 showing that the maximum absolute value displacements must be added. Cameras may also be used to help with the investigation of failure modes.

Sensor Rules

- All accelerometer locations specified in VMA1826 §4.1.2.2.1.
- Displacement potentiometers at all equipment external connection points (Gas lines, coil lines, etc.).
- Onboard cameras at any expected low-resistance interfaces or structurally marginal locations.

4.1.2.3.2 Test Verification

Seismic test verification to standards such as AC156 can be done by identifying a few rules for spectral response success. Just as a seismic test tests the structure and functionality of the equipment, there are also ways in which the test can be valid only for a lower seismic qualification level because of underpowered excitation. The reasons for this occurring are usually the highly non-linear response of moving mass (such as fluids), deforming rigid bodies (yielding), or high center-of-gravity inertial response.

To reduce the effects of the non-linear response interfering with the level of seismic certification due to dips in the test response spectrum, sometimes it is advised to do a reduced seismic event at somewhere between 10% to up to 50% of the target seismic certification level. The higher the test level, the more fatigue energy will be transferred into yielding subassembly connections which can lower the natural frequency and drastically effect the performance at the target end seismic event.

In general, it is required that a 100% seismic strength tuning test be done on the shake table with a dummy mass of at least 75% of the total test mass to be tested. This percentage includes the addition of the shake table frame and fixture.

4.1.2.3.2.1 Test Response Spectrum (TRS)

The test response spectrum 'TRS' has several pass criteria, which are introduced in AC156. Similar requirements are imposed by other standards such as IEEE344 for nuclear and GR-63 for utilities.

General Requirements (AC156)

- All TRS accelerations shall be ≥ 90% RRS at 1/6th octave intervals.
- Maximum of (2) points may fall below 100% RRS between 1.3 Hz ≤ f ≤ 8.3 Hz.
- Maximum of (2) points may fall below 100% RRS between 8.3 Hz ≤ f ≤ 33.3 Hz.
- No two failed points may occur at adjacent 1/6th Octave points.
- Lowest enveloped frequency shall be ≥ 75% lowest natural frequency measured from the accelerometers.

4.1.2.3.2.2 Post-Shake Functionality Requirements

After the seismic event, a full functionality check must be completed which is identical to the pre-shake functionality verification described in section VMA1826 §4.1.2.1.3.

Functionality Rules

- All functionality general requirements in VMA1826 §4.1.2.1.3.
- Post-Shake functionality must be witnessed by laboratory staff, a manufacturer's qualified representative (or technician), and a representative

for the engineer of record and/or engineer of record in person.
- For post-shake functionality testing performed at the manufacturer's facility, a representative from the Certifying Agency shall be present at the test and also the arrival of the unit to the factory for inspection.
- Special consideration for importance factor of 1.0 and 1.5 must be included. This requirement is imposed in AC156 §6.8.2.
- For equipment with target certification of Ip = 1.0, the equipment cannot pose a life or limb safety hazard due to collapse or separated subassemblies and is not required to function after the seismic event.
- For equipment designated Ip = 1.5, it is deemed essential for facility operation and thus it must maintain critical functionality in accordance with AC156.
- Minor repairs to the UUT are allowed and must be included in the laboratory report with picture or diagram documentation adequately displaying the extent of the anomaly.
- If the minor repair requires a design change the design change requirements shall be included in the final test report
- All repairs must be completed within 3 hours of the problem being identified and hands-on analysis being started. The repair must involve in the final work-around, only simple repair tools which will be required at the facility at which it is installed. Replacement components or dislodged materials which do not interfere with normal operation but are required to be replaced to fully function will be required to be stored in a location where, after a seismic event, replacements will be accessible.
- If any additional training can be supplied to maintenance staff to ensure adequate operation after an earthquake can be provided by the manufacturer, it is required that this program be setup and become part of the quality control methods of the destined facility.

4.1.2.4 Lab Report Document

Lab reports require a plethora of information to fully describe such complex test specimens, results, and ending knowledge. Below is a list of required material in a lab report issued by a qualified laboratory. For the definition of a qualified laboratory, see section VMA1826 §4.1.3.

- Document reference number (specific to lab report) on all pages.

- Page numbers in form (Page X of Y) on all pages.
- Laboratory description including headquarters and contact.
- Certification Agency description including headquarters and contact.
- Manufacturer description including headquarters and contact.
- Table of contents/pictures/figures/diagrams/equations.
- Release validation (signatures of release for use).
- Revision history (signatures and change summary).
- Engineer of record PE stamp or SE stamp (state-dependent); this engineer of record must be the same as the one responsible for the test plan.
- Testing standard and revision in compliance.
- Scope of testing.
- Summary/statement of completeness as per the test plan goals.
- Table which contains all specimen configurations and test numbers used in the data plots in the rest of the report.
- Test names of each UUT (must match test labels).
- Description of UUTs (dimensions, weights, industry-used size).
- Mounting of UUTs (anchor type/size/count, installation orientation).
- Instrumentation locations (list required sensitivity and limits, global names).
- Description of all anomalies as described in AC156 (damage patterns and failure modes such as cracking, fallout, brittle or ductile fractures, yielding, and excessive deflection or distortion).
- Natural frequency transfer plots with lowest natural frequencies labeled.
- Time history shake table excitation plotted acceleration against time showing ZPA requirement was achieved (+/- 90% ZPA) lines must both be included. The total test duration must be a minimum of 30 seconds. The strong motion duration must be a minimum of 20 seconds long.
- TRS plots with 90% and 130% RRS lines shown as well as cursor call-outs of any adjacent failure point accelerations shown
- Statistically independent motion calculations showing either coherence plot or correlation plot in accordance with IEEE344 Annex E. The same limits will be enforced such that a maximum of 0.5 for coherence and 0.3 for correlation are required for valid seismic simulation.
- Detailed description of test specimens including manufacturer, industry-used capacity, type or category, primary materials and associated standards, dimensions, and weights.
- Original annotated test plan or revised test plan described in section VMA1826 §4.1.1.3.
- Signed pre-shake and post-shake functionality sheets
- Reference materials (for any post-processing/ pre-processing data).
- List of calibrated equipment (including a statement of compliance with ISO 17025 calibration requirements).
- Design change requirements that resulted from minor anomalies.
- Minor anomalies are acceptable and are described in AC156.

- All photographs shall be digital (high resolution) at a minimum of 300 dpi, and clearly identify the objects in the photo.
- All UUT's shall be individually photographed in their installed configuration, and be clearly labeled in the report.

4.1.3 Laboratory Qualification

4.1.3.1 Laboratory Certification

Test lab shall be accredited by IAS, ILAC, or APLAC MRA and comply with ISO 17020 and/or ISO 17025 as applicable,

Or

Be successfully audited by a third party to the requirements of ISO 17025.

4.1.3.2 Calibration

All testing labs shall provide documentation of current calibration for all equipment used to verify the required test parameters. These parameters include, but are not limited to, complete Seismic Response Spectrum (SRS) data, all seismic accelerations and natural frequencies, resonant frequencies in all three orthogonal directions, equipment weight and overall unit dimensions. Calibration documents shall follow industry standards and include certification by a certified calibration laboratory, per ISO 17025.

4.1.3.3 Quality Control

Testing laboratories that are not certified per ISO 17025 shall demonstrate a Quality Assurance Program which specifies controls for at least the following areas:

- Existence of corporate quality assurance guidelines
- Documentation control
- Calibration standards
- Maintenance records
- Internal auditing

And have successfully completed a third party audit to the requirements of ISO-17025 within the last three years.

4.1.3.4 Shake Table Performance Specification

[See FEMA461 for detailed information]

4.1.3.5 Data Acquisition

Data acquisition usually contains several components such as sensors that turn physical parameters into analog signals, analog signal filters,

analog-to-digital converter, and software to help store the data for later processing.

- Calibration must conform to NIST traceable primary standards.
- Data acquisition systems must be calibrated at least once a year.
- Calibrations must be verified before each test.
- Sampling rate must be at least 200 Hz.
- All data must be filtered with a low-pass filter at no lower than 100 Hz.

See FEMA461 §3.5 for more information on calibration requirements.

4.2 Analysis

4.2.1 Usage Constraints

Using analytical methods to certify nonstructural components is limited to non-active or non-energized components, such as structural supports and attachments and external enclosures that do not support active components. Structure that is deemed to be flexible and supports active or energized components cannot use analysis as a basis of certification. Flexible supports are those that have a primary natural frequency of less than 16.7 Hz.

All analysis shall be performed using building standard load combinations, material allowables, and standard practice. Allowables for all fasteners shall be verified by test by either the manufacturer of the component being certified or the supplier of the fasteners. For structural steel elements, AISC standard practices shall be used. For thin panels, AISI standard practices for cold-formed sheet metal shall be used.

4.2.2 Interpolation Method

For product line certification of components by analysis, a different interpolation method for intermediate sizes must be used than with testing. An analysis of each design break in the product line is required. Where structure changes in size, strength of flexibility, a separate analysis of those sizes is required. Examples of design breaks are:

- Change of support channel size.
- Change of material thickness.
- Change in the number of support points.
- Increase in the mass of supported components.

The analysis of each size shall assume a structural configuration having the least seismic resistance, and include the heaviest supported configuration.

The horizontal seismic load shall be applied in all principal directions as determined by the attached components and the support points of the component being certified. That is, separate loading conditions must be applied to ensure the worst-case analysis is being performed.

4.2.3 Extrapolation Method

For product line certification of components by analysis, extrapolation of sizes to be analyzed is not allowed. The largest size component to be certified shall be analyzed. Analysis shall include worst case loading and least seismic resistance.

5. OPERATIONS REQUIREMENTS

5.1 Production Tests & Internal Audit by the Manufacturer

Periodic production tests must be conducted by the manufacturer to ensure the seismic adequacy of equipment being sent to a seismic locale. Typically these checks can be worked into quality control procedures and sometimes require no modifications to existing systems. An internal auditing procedure or log must be maintained to indicate the date, time, model and by whom the periodic tests were conducted. At a minimum the following inspections must take place.

5.1.1 Model, Size and Factory Verification

All equipment being given seismic certification must be listed as certified on the label. Specifically, the model number, size (industry specific), and manufacturing facility must fall within the bounds of the certification details.

5.1.2 General Dimension Confirmation

Equipment which is designated as a seismic installation must have all basic dimensions confirmed to be within the limitations of certification. If the maximum length, width, depth, or weight is out of the limitations, immediate confirmation with the certification agency is required. Typically, ±10% is allowed unless it is revealed that subcomponents have substantially changed. See VMA1826 §1.5 for more information on maintaining certification.

5.1.3 Special Seismic Certification Requirements

All conditions of approval specified in the approved certification application must be accounted for in addition to any design modifications specified during the seismic qualification process. See VMA1826 §2.2.2 for more information about the special conditions of approval listed on the certification application. The manufacturer shall notify the listing agency of changes which effect strength, stiffness, size, weight, materials, support, orientation, or manufacturer is modified such that the product/s are no longer equivalent to what was approved in the VMA. Significant changes which degrade the seismic capacity of the equipment will result in the nullification of certification of that specific product that was produced. To maintain certification on modified designs, the maintenance program must be followed. See VMA1826 §6.

5.2 External Auditing

In order to be listed on the IBCapproval.com website, an engineering and QA audit of the product and each manufacturing facility must occur within one year of successful testing. Annual engineering and QA audits are required and may take place remotely by the manufacturer, providing proper evidence and documentation as required by the auditor is furnished. If further investigation is required an audit may be deemed necessary at the manufacturing facility. At a minimum, one physical audit at the manufacturing facility and two remote audits must take place over the certification period.

The auditor, in advance of the physical audit, shall request the following items from the manufacturer who shall provide these items prior to the onsite audit.

- Representative top-level drawings for at least one in-scope model.
- Bills of materials.
- Change history log.
- Scanned copies of applicable labels.
- Results of any prior audits for the model currently under audit.

The auditor shall provide to the manufacturer, prior to arrival, an audit checklist and agenda for the physical meeting. The agenda will consist of, but is not limited to, the following:

Auditor holds opening meeting covering the following.

- Introductions.
- Manufacturer facility site rules and regulations, protective wear, etc.
- Customer quality management system: Certification to ISO 9000 (for example), with a focus on the site's processes for managing changes to documentation, including engineering change notices, bills of materials and work instructions.
- Scope: A review of the IBC® Certificate of Compliance, applicable models which are available for the physical audit
- A review of all changes since receiving the certificate of compliance, approved changes and pending changes as well as future plans for design change

During the audit, at a minimum, the auditor shall collect from the manufacturer and review the following:

- C of C.
- Label.
- Seismic certification report.
- Any applicable information or documentation deemed necessary by the auditor during the inspection to substantiate compliance.

5.2.1 Procedure

Based upon the audit checklist, in addition to the documentation noted above, the auditor will request an in depth example of selected ECOs (Engineering Change Orders) that could affect seismic integrity and/or certification.

The auditor shall also ask for objective evidence of implementation of any applicable DCR (Design Change Requirements) as listed in the seismic certification report.

Subsequently, the auditor shall traverse to the manufacturing floor to physically observe certified units or similar in actual production. The objective shall be to see evidence of DCRs applied, witness proper label application, including label content, as well as observe approved components are being utilized, i.e., proper gauge measurements on components that have had ECOs.

A closing meeting will be held and a preliminary overview of the auditor's findings is discussed.

5.2.2 Post Field Audit Procedure

The auditor prepares field notes. A preliminary audit report is prepared. From the preliminary report and the field notes, an engineering disposition form is completed for any items in question. The disposition is distributed to the engineer of record/project engineer. A review meeting is scheduled to discuss the field audit findings. All dispositions are included in the preliminary audit report, as well as any applicable Corrective Action Requests (CARs) are issued.

If a CAR is issued, a response is requested from the customer within 30 days. The auditor along with the engineer of record/project engineer will review the response to the CAR to determine the effect upon the certification renewal.

- If the responses are acceptable or non-impacting, re-certification may proceed.
- If the responses are unacceptable or have impact on the certification, additional determination of the level of impact occurs. If CARs cannot be corrected without additional testing, the customer will be notified that the certification is nullified and marked expired on the listing site, www.ibcapproval.com.

A final audit report is prepared. The packet includes an updated C of C, the audit report and a completion letter, along with instructions on how to access www.ibcapproval.com.

6. MAINTENANCE PROGRAM

In order to facilitate manufacturer design changes to the certified product line, the manufacturer shall adhere to the maintenance program as defined herein. There are three stages of design modification review: Preliminary Design Review (PDR), Formal Design Review (FDR) and a Site Visit.

6.1 Preliminary Design Review (PDR)

The preliminary design review is done to find out if the modifications have affected the status of certification. When a review is done, it is organized in a specific way so

as to standardize the system of review. The primary format is divided between the reason and the modification itself.

6.1.1 Justification for Modification

A justification for the modification must be denoted as a cost savings, field request, new product introduction, or other similar reasoning. The purpose of the change is important to help identify the justification for an in-depth review by the certification agency. Whenever a modification is required, the process should involve the applicability to seismic certification revalidation.

The three basic questions to be addressed are:

1. *What is the purpose of the change?*

    - Cost savings?
    - To facilitate manufacturing?
    - Field request (customer special)?
    - New product introduction?

2. *Has the geometry or weight changed?*

    - Length?
    - Weight?
    - Height?
    - Center of gravity?

3. *Has there been a material change?*

Material change as defined by California Administrative Code, 2010 Section 7-111.

Or

Strength, stiffness, size, weight, materials, support, orientation, or manufacturer is changed/altered so that they are no longer equivalent to what was certified and approved.

6.1.2 Scope of Modification

The scope of the design modification must be known to the certification agency handling the review. How many model sizes are affected by the change can dramatically increase complexity of maintenance.

6.2 Formal Design Review (FDR)

For the formal design review, a detailed questionnaire must be filled out by the customer. The overall size, mass, structural members, material properties, fasteners, welds, accessories, component manufacturers, component attachments, isolation, panel sizes, silencers, tanks, and manufacturer processes must be evaluated.

6.2.1 Design Review Questionnaire

- Overall size?
- Mass?
- Structural Members?
- Material Properties?
- Fasteners?
- Welds?
- Accessories?
- Component Manufacturers?
- Component Attachments?
- Isolation?
- Manufacturing Process?

6.3 Facility Visitation

If or when the PDR and FDR cannot provide sufficient or clear enough information to conclusively determine a disposition, a site visit will be required to obtain a clear understanding of the change and investigate and review the actual design change.

Appendix A - Units of Measurement and Tolerances

Units of Measure:		Symbol
Force (Load):	Pounds	#
Acceleration:	Percent of gravity	g's
Percent of gravity =	Applied force on an object divided by its weight	
Length, displacement:	Inches	"
	Feet	'
Frequency, cycles per sec		Hz
Moment or Torque		in# or ft#
Speed		in/sec or ft/sec
Temperature		°F

Tolerances:

All dimensions or values measured and/or reported on documents required for approval must meet these minimum requirements:

Force	+/-1%
Acceleration	+/-0.03 g's
Frequency	+/-0.2 Hz
Length	+/-0.030" Up to 10"; +/-0.060" Over 10"
Time	+3/-0 Seconds
Temp	+/-3°F

Appendix B – Approval Certification Mark & Usage

Only manufacturers who have earned IBC® certification through The VMC Group may use The VMC Group IBC® Certified logo. The logo's usage is reserved strictly for products that have received a VMA Number. The VMC Group IBC® Certified logo may only be used during the time period that the product is certified.*

Artwork

There is no minimum size requirement for the mark, but it must be large enough to be readily identifiable. The mark should be produced in color or black and white on a light background or in reverse on a dark background.

The VMC Group IBC® Certified logo is available in the following formats:

- Two color logo (VMC Pantone 116 and black)

- Black and white logo (white background with black text)

- Reverse logo (black background with white text)

Consistent use of the logo promotes awareness of this Special Seismic Certification, increases the impact of the qualification, and ensures that our customers maintain a competitive edge. In order to ensure consistency of use of The VMC Group IBC® Certified logo, please ensure that the following guidelines are adhered to:

- Color:

  The VMC Group IBC® Certified logo may only be used in its color version (which is Pantone 116, black and white) or its black and white only versions.

- Size:

  When used at a different size than supplied, the entire VMC Group IBC® Certified logo must be scaled in proportion to its original measurements. The logo may not be modified, redrawn or distorted in any way.

- Usage:

  Only manufacturers who have earned IBC® certification through The VMC Group and been issued a VMA Number, may use The VMC Group IBC® Certified logo on the products that were successfully tested. The logo may only be used throughout the certification time period.

The logo may be used on the product and within related marketing, public relations, advertising, catalogs and product packaging. When a VMC Group IBC® Certification logo is used in advertising material or on product packaging, all material must reflect the specific circumstances under which the product was The VMC Group IBC® Certified. The material must clearly differentiate between products that are The VMC Group IBC® Certified and those that are not, and may not, in any way, imply a more substantial relationship with The VMC Group.

The VMC Group IBC® Certified logo may not be used on business stationary or business signage regardless of its end use.

Unacceptable uses of the marks include, but are not limited to, adding/deleting wording or artwork, reducing the artwork to an illegible size, animation or distortion.

The text of The VMC Group IBC® Certified logo may not be translated into any language other than English.

The VMC Group IBC® Certified logo may not be preceded by or followed by a qualifier that indicates a degree of certification or acceptability such as "first", "only" or "exceeds".

Restrictions

The VMC Group IBC® Certified logo or any aspect thereof may not be incorporated as part of a business name, Internet domain name, or brand name/trademark for a product/products or a product line. This includes both design aspects (The VMC Group "circle") and word aspects (The VMC Group IBC® certified, etc.). The use of any "The VMC Group IBC® Certified" logo or words as a trademark is strictly prohibited.

The approval standard number or VMA Number may not be incorporated as part of a business name, Internet domain name, or brand name/trademark for a product/products or a product line. For example, a company may not say "XYZ Company's 1826 Transfer Switch is The VMC Group IBC® Certified. The proper terminology is, XYZ Company's Transfer Switch is The VMC Group IBC® Certified per Approval Standard 1826."

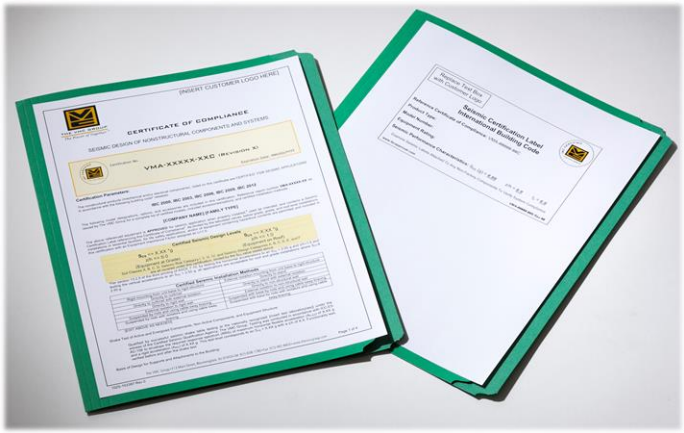
Products may not be marketed under any mark or name similar to The VMC Group or any of The VMC Group certification marks. Further, products may not be marketed to imply a relationship beyond the scope of any certification made by The VMC Group.

A company may not reference the intent to submit a product for Special Seismic Certification by The VMC Group or represent in any way that a certain product will be certified by The VMC Group in the future. For example a company may not say "Special Seismic Certification by The VMC Group is pending" or "The VMC Group Special Seismic Certification applied for."

** The VMC Group retains the right to issue notice to manufacturers that they may no longer use The VMC Group IBC® Certified logo once the certification period expires. User agrees to conform and remove/stop using the logo following expiration.*

Appendix C – Sample C of C, Label, UUT, Test Report

Certificate of Compliance (C of C & Label)



UUT

Test Report

Revision History

Rev.	Description	Date
0	Preliminary Draft	6/2014
1	Initial Release	8/2014
2	Editorial Revisions/Formatting	9/2014
3	Edited for Scheme	5/2015