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Standard Specification for High-Rise Multi-Story Building External Evacuation Controlled Descent Devices¹

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1. Scope

1.1 This specification covers the requirements, performance, design, marking instructions, test methods and ancillary components of High-Rise Multi-Story Building External Evacuation Controlled Descent Device (CDD) systems for emergency escape of persons who cannot use the standard exit facilities in high-rise multi-story buildings, defines requirements for their installation, periodic maintenance when installed and instructions for their use.

1.2 This specification does not apply to personal escape parachutes, rope, chain ladders or rappelling devices.

1.3 This specification does not apply to ancillary components used with and included in CDD systems, harnesses, connecting hardware, signage, special evacuation openings, personal protection equipment or devices and other components used on CDD systems which may be installed, purchased or used in accordance with the requirements specified herein.

1.4 The values stated in SI units are to be regarded as the standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

B 117 Practice for Operating Salt Spray (Fog) Apparatus

E 488 Test Methods for Strength of Anchors in Concrete and Masonry Elements

E 631 Terminology of Building Constructions

E 894 Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings

E 1512 Test Methods for Testing Bond Performance of Bonded Anchors

E 2265 Terminology for Anchors and Fasteners in Concrete and Masonry

2.2 ANSI Standards:

ANSI Z359.1 Fall Arrest System Components³

ANSI/AWS D, 14.4 Specification for Welded Joints in machinery and Equipment³

2.3 ASCE Standard:

ASCE 1-05 Minimum Design Loads for Buildings and Other Structures⁴

2.4 ASME Standard:

ASME A120 Safety Requirements for Powered Platforms for Building Maintenance⁵

2.5 International Standards:

CSA-Z259.10 Full Body Harness, M90⁶

CSA-Z259.2.3-99 Descent Control Devices⁶

EN 292-1:1991 Basic Design Concepts and general Principles of Design for Safety Machinery⁷

EN 362 Connectors and Attachment Hardware⁷

¹ This specification is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.77 on High Rise Building External Evacuation Devices.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁴ Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, <http://www.asce.org>.

⁵ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

⁶ Available from Canadian Standards Association (CSA), 5060 Spectrum Way, Mississauga, ON L4W 5N6, Canada, <http://www.csa.ca>.

⁷ Available from European Committee for Standardization (CEN), 36 rue de Stassart, B-1050, Brussels, Belgium, <http://www.cenorm.be>.

EN 1497 Rescue Equipment-Rescue Harness⁷

EN 1498 Rescue Equipment Class B-Rescue Harness⁷

EN 1891 Personal Protective Equipment⁷

PrEN 341:2002 Personal Protective Equipment for Protection Against Falls from Height⁷

2.6 *ISO Standards:*

ISO 9002 Quality Management and Manufacturing Quality Assurance⁸

ISO 10333-5 Connectors and Attachment Hardware⁸

2.7 *NEMA Standard:*

NEMA 250 Enclosures for Electrical Equipment⁹

2.8 *NFPA Standard:*

NFPA 130 Appendix B 2.1.1 and B 2.1.2¹⁰

2.9 *OSHA Document:*

OSHA Safety and Health Bulletin, SHIB 02-24-2004 Suspension Trauma/Orthostatic Intolerance¹¹

2.10 *UL Standard:*

UL 1523 Controlled Descent Devices for Marine Use, 9, 15, 16, 17 and 18¹²

3. Terminology

3.1 See Terminology E 631 for definitions of general concepts related to building construction.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 ~~high-rise buildings—any building that is 35 m, or more in height.~~

~~NOTE 1—CDD systems specified by this standard may be used from any floor or the roof of a high-rise building.~~

~~3.2.2 controlled descent device, (CDD) system— a system that lowers one or two people per descent, at a controlled rate of descent, with each person wearing a rescue harness, on the outside of a building, from an upper level to the ground or other safe location.~~

~~3.2.2.1~~

~~3.2.1.1 controlled descent device (CDD)—a device that is an integral part of all CDD systems, which controls the rate of descent.~~

~~3.2.2.2~~

~~3.2.1.2 automatic controlled descent device—a CDD that provides automatic control of the rate of descent without any action required of the user.~~

~~3.2.2.3~~

~~3.2.1.3 automatic controlled descent device, with manual override—a CDD that provides automatic control of the rate of descent with a manual override capability which gives the user the ability to slow or stop the descent.~~

~~3.2.3~~

~~3.2.2 force limiter—a mechanism that limits the force on the user, rescue line, rail or track and all in line, load bearing CDD system components and parts to a specific value during deceleration.~~

~~3.2.4~~

~~3.2.3 one time rescue CDD—a CDD system or CDD that is capable of only one rescue descent.~~

~~3.2.5~~

~~3.2.4 repetitive rescue CDD—a CDD system or CDD that is capable of being returned to the site of descent initiation and used repetitively.~~

~~3.2.6~~

~~3.2.5 multiple rescue CDD system—a CDD system capable of multiple rescues using multiple, one time rescue CDDs and a descent rail or track.~~

~~3.2.7~~

~~3.2.6 rescue harness—an adjustable human body holding device or harness assembly, which supports the pelvis and the torso.~~

~~3.2.7.1~~

~~3.2.6.1 separate rescue harness—a rescue harness is a separate component of the CDD system that connects to a rescue line or the CDD.~~

~~3.2.7.2~~

⁸ Available from International Organization for Standardization (ISO), 1 rue de Varembe, Case postale 56, CH-1211, Geneva 20, Switzerland, <http://www.iso.ch>.

⁹ Available from National Electrical Manufacturers Association (NEMA), 1300 N. 17th St., Suite 1752, Rosslyn, VA 22209, <http://www.nema.org>.

¹⁰ Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, <http://www.nfpa.org>.

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¹² Available from Underwriters Laboratories (UL), 333 Pfingsten Rd., Northbrook, IL 60062-2096, <http://www.ul.com>.

3.2.6.2 integral rescue harness—a rescue harness is an integral part of a descending CDD system.

3.2.8

3.2.7 rescue line—a flexible cable or rope that is used to support individuals during descent.

3.2.8.1

3.2.7.1 anchored rescue line—a rescue line that is anchored at the descent initiation location and is dispensed from or passes through a descending CDD.

3.2.8.2

3.2.7.2 descending rescue line—a rescue line that is dispensed from or passes through a CDD that is anchored at the descent initiation location.

3.2.9

3.2.8 descent rail or track—load bearing assemblies on which CDDs are mounted, inserted or attached and secured. Descent rails and tracks are components of CDD systems that are pre-installed on the outside of buildings and joined together in sections on which specially designed CDDs are supported during controlled descent.

3.2.10

3.2.9 special evacuation opening—a pre-installed special or modified window or door that can be opened to allow access to the outside of a building during an emergency.

3.2.11

3.2.10 rated load—the weight of the person or persons being rescued including items worn or carried. The weights of system component parts that descend are not included in the rated load.

3.2.11.1

3.2.10.1 minimum rated load—the lightest weight of a person, including items worn or carried that must result in a controlled descent, within the required rate of descent limits.

3.2.11.2

3.2.10.2 maximum rated load—the heaviest weight of the person or persons, being rescued, including items worn or carried that must result in a controlled descent, within the required rate of descent limits.

3.2.12

3.2.11 anchorage—the physical weight bearing attachment of a CDD, rescue line or any part of a CDD system, to a building including the attachment of rails or tracks.

3.2.13

3.2.12 maximum rated height—the highest elevation from which a specific CDD may be used.

3.2.14 3.2.13 total descent energy—The total descent energy W , expressed in Joules is the energy that must be dissipated by a CDD during use. It is equal to the product of the descent load (m) multiplied by the acceleration of gravity, (g) times the height of the descent, (h) times the number of cycles, (n); $W = m \times g \times h \times n$

3.2.14.1

3.2.13.1 Discussion—Total descent energy manifests as heat energy that must be dissipated by CDD systems during use and is a critical parameter that must be accounted for in the thermal design of each system according to its Class and its maximum rated height.

3.2.15

3.2.14 static load—the specified steady state load, expressed in Kilo Newton that must be supported by the CDD, rescue line, rail, track, connector, connection hardware, mounts and anchors.

3.2.16

3.2.15 dynamic load—the dynamic load that results from free-fall, expressed in Kilo Newton that must be supported by the CDD, rescue line, rail, track, connector, connection hardware, mounts and anchors.

3.2.17

3.2.16 free fall—uncontrolled descent.

3.2.18

3.2.17 suspended trauma syndrome—a sometimes fatal condition caused by blood pooling when the legs are kept motionless in the vertical downward position during the period of suspension in some types of harnesses.

3.2.19

3.2.18 re-certification—the process by which the manufacturer or their representative repairs or refurbishes CDD systems, and approves them for additional use.

3.2.20

3.2.19 hazard and safety assessment—the process, involving hazard and safety evaluation, to determine that the safety and health hazards associated with the installation and use of a CDD system are acceptable.

4. Significance and Use

4.1 *Purpose*—This standard defines the design, materials, physical properties, operation and testing requirements for CDD systems, for use as a last resort for the external evacuation of people from high-rise multi-story buildings.

4.2 *Test Requirements*—The test requirements contained in Section 16 are for the purpose of design verification and

certification, that CDD Systems comply with the requirements of this standard. Each manufacturer, in concert with the testing authority shall develop detailed test plans and procedures, based on the requirements of Section 16.

4.3 *Test and Inspection Documentation*— All tests and inspections shall be fully documented and retained by the testing authority and the manufacturer.

4.4 *Installation, Instruction and Periodic Maintenance* —This standard also defines requirements for the installation, instruction of those intending to use the CDDs and periodic maintenance of installed CDD systems.

4.5 *Hazard and Risk Analysis*—The standard also includes requirements for hazard and risk analysis.

5. CDD Classification

5.1 Type designates automatic control or automatic control with manual override capability and indicates whether or not a force limiter is employed.

5.2 Grade designates storage or permanent mounting of the CDD System or its components on the inside or outside of a building.

5.3 Class designates CDD Systems with one time rescue, repetitive rescue or multiple rescue capability, with the maximum rated load capability for one person or for two people per descent.

NOTE 2—~~The 1~~—The maximum rated height of a given CDD is a function of the specific Class of the CDD system, its total descent energy dissipation capability and the length of the rescue line, etc. The manufacturer shall define the maximum rated height for each of their specific CDD systems in compliance with the requirements of sections 8.7 through 8.7.10.

5.4 *Classification by Type*—Each CDD system and its CDDs shall be designed for use with rescue lines, with descent rails or with descent tracks. Type designates CDD systems with automatic descent control, automatic descent control with manual override capability and whether force limiters are or are not employed.

5.4.1 *Type I*—Automatic descent control CDD system.

5.4.2 *Type II*—Automatic descent control CDD system, which employ a force limiter.

5.4.3 *Type III*—Automatic descent control CDD system, with manual override capability.

5.4.4 *Type IV*—Automatic descent control CDD system, with manual override capability that employs a force limiter.

5.5 *Classification by Grade*—Classification by grade identifies CDD systems, CDDs, and component parts of CDD systems that are stored or installed inside or outside of buildings.

5.5.1 *Grade 1*—A CDD system designed for storage or installation outside of a building.

5.5.2 *Grade 2*—A CDD system designed for storage or installation inside of a building.

5.5.3 *Grade 3*—A CDD system designed for the storage or installation of some components or parts of the system on the inside and some stored or installed on the outside of a building.

5.6 *Classification by Class*—Classification by class defines CDD systems with anchored CDDs and descending rescue lines, anchored rescue lines with descending CDDs, repetitive or one-time rescue descent CDDs, one person or two person rescue capability, CDDs that are used on rails or tracks, and the maximum rated load.

NOTE 3—Classes I and J CDD systems shall be limited to the rated height of 35 m, reference sections 8.7.9 and 8.7.10.

6. Ordering Information

6.1 CDD systems may be purchased by individual apartment or high-rise Condo dwellers and families, ~~high-rise multi-story~~ building business tenants; for their employees and ~~high-rise multi-story~~ building owners or others requiring a last resort means of evacuation. These systems may be ordered by Type, Grade and Class, based on the requirements of the purchaser. The selection of CDD systems may be based on any combination of Type, Grade and Class, in order to achieve the required capability.

6.2 *Height of Use*—The height of intended use, based on the purchaser’s requirements, must be specified for each CDD system and CDD purchased.

6.3 *Assistance*—The CDD system manufacturer or the manufacturer’s representative shall provide assistance and guidance to the purchasers of CDD systems, in the selection process and shall assist with or perform the installation, of the system.

TABLE 1 CDD Systems by Class

Class	Anchored CDD	Anchored Rescue Line	Rails or Tracks	Repetitive Rescues	One Time Rescue	Number per Descent	Maximum Rated Load
A	X			X		1	135 kg
B	X			X		1 or 2	180 kg
C	X				X	1	135 kg
D	X				X	1 or 2	180 kg
E		X			X	1	135 kg
F		X			X	1 or 2	180 kg
G			X		X	1	135 kg
H			X		X	1 or 2	180 kg
I	X	or	X		X	1	135 kg
J	X	or	X		X	1 or 2	180 kg

6.3.1 *Number and Location of CDD Systems*—The manufacturer shall evaluate the requirements of the purchaser regarding the number of people that must be evacuated, the location of those people within the building and then determine the number of CDD systems required and the installation location of each system.

6.3.2 *Special Requirements*—The manufacturer or their representative shall identify any special user needs, such as special rescue harnesses or accessories, and any unique conditions that must be accommodated. The manufacturer or their representative shall prescribe special rescue harnesses and accessories to the purchaser when necessary and assure that any unique conditions are considered in the installation.

6.3.3 *Instruction*—The manufacturer or his representative shall provide instruction to each purchaser in the proper use of the CDD system.

7. Materials and Manufacture

7.1 *Structural and Mechanical Components*—Structural and mechanical component parts of CDD systems shall be fabricated from structural materials that will withstand the required static and dynamic loads and other requirements of this standard, including environmental and climatic conditions. Verification shall be by analysis of the manufacturer’s technical documentation and testing in accordance with Section 16.

7.2 *Durability and Shelf-Life*—~~Materials used in CDD Systems shall be selected to provide a minimum shelf-life and durability of 10 years, necessary to support storage and installation periods, inside or outside of buildings in any area of the world where high-rise buildings exist for a minimum of 10 years.~~ Materials used in CDD Systems shall be selected to provide a minimum shelf-life and durability of 10 years, necessary to support storage and installation periods, inside or outside of buildings, based on their grade, (see 5.5.1 or 5.5.2), for a minimum of 10 years in any area of the world where multi-story buildings exist.

7.2.1 *Durability Verification Analysis*—The manufacturer shall perform a shelf life and durability analysis of their specific CDD system and establish periodic inspection, statistical or other testing and to determine the need for any required periodic inspection and maintenance that is necessary to assure a minimum of 10 years shelf life and durability.

7.2.2 *Inspection and Maintenance*—The manufacturer or their representative shall perform any required inspection and maintenance that is determined to be required after the CDD system has been installed.

7.3 *Connectors and Attachment Hardware*—Connectors and attachment hardware shall be selected by the manufacturer from products constructed and tested in accordance with the requirements of either CSA Z259.2.3-99, EN 362 or ISO 10333-5. Connectors and attachment hardware shall have automatic or manual locking gates. Verification shall be based on vendor certifications and by testing of the CDD in accordance with ~~section 16.1~~ Static Strength Test and 16.2 Dynamic Strength Test.

7.3.1 *CDD Attachments to Rails or Tracks*—The mechanisms that attach CDDs to rails or tracks shall be fail safe by design to include interlocks or other mechanisms that prevent separation of the CDD from the rail or track and separation of rail or track sections from each other. Provisions in the system design shall be included to prevent any possibility of dropping the CDD during the process of mounting, attachment or any other activity associated with preparing the CDD for descent. Verification shall be accomplished by testing in accordance with sections 16.1 and 16.2 and by inspection and analysis of the manufacturers design documentation and operating procedures.

7.4 *Surface Finish*—All surfaces shall be clean and free of scale, rust and deposits of foreign matter. Surfaces that come in contact with material that can be torn shall be free of burrs, pits, sharp edges and rough surfaces. Verification shall be by inspection.

7.5 *New Condition*—All component parts shall be new and in unused condition when incorporated into CDD assemblies when they are manufactured and initially put into service. Verification shall be by inspection and review of manufacturer’s documents.

7.6 *Welding*—All structural welds shall be visually inspected over their entire lengths. Acceptance criteria of welds and repairs shall be in accordance with ANSI/AWS D, 14.4. Verification shall be by inspection and review of the manufacturer’s quality assurance documents.

7.7 *Storage and Operating Temperature*—~~Materials used in CDD Systems shall be selected for compatibility with the requirement to provide reliable performance at ambient temperatures based, on their Grade. Grade I CDD systems and those components of Grade III CDD systems, stored in locations outside of buildings, shall be capable of the required performance at operating temperatures ranging from -35°C to $+60^{\circ}\text{C}$. Grade II CDD systems installed and stored inside of buildings shall be capable of the required performance at operating temperatures ranging from -20°C to $+55^{\circ}\text{C}$. Verification shall be by testing in accordance with Section~~ Materials used in CDD Systems shall be selected for compatibility with the requirement to provide reliable performance at ambient temperatures based on their Grade. Grade 1 CDD systems and those components of Grade 3 CDD systems, stored in locations outside of buildings, shall be capable of long term storage and shall be capable of the required performance at ambient temperatures ranging from -35°C to $+60^{\circ}\text{C}$. Grade 2 CDD systems and those components of Grade 3 systems stored inside of occupied buildings shall be capable of long term storage at ambient temperatures common to the interior of occupied buildings and shall be capable of the required performance at ambient temperatures ranging from -20°C to $+55^{\circ}\text{C}$. Verification shall be by testing in accordance with Section 16.

7.8 *Protection from Solar Radiation and Other Environmental Factors*—CDD systems and their component parts made of materials that may degrade due to exposure to sun light or other environmental factors shall be protected against such degradation by shielding or other means. Verification shall be in accordance with Section 14.

7.9 *Corrosion Prevention*—CDD Systems shall be designed to avoid corrosion and galvanic action that could reduce the strength or performance capability of any component. One or more of the following shall be included in the design to prevent

galvanic action and oxidation; avoid the use of dissimilar metals, use hot dip galvanizing, inorganic zinc coating or use other methods to provide protection or use moisture control to prevent galvanic action and oxidation. Verification shall be by conditioning in accordance with the requirements of Section 14 as required by type and by inspection.

7.10 *Rescue Lines*—Rescue lines shall be made from steel wire rope, textile rope, polymer fiber ropes, webbing or composite materials and comply with the requirements of this standard sections 9.2 and 9.3. Rescue lines shall be designed so that a tool must be used to remove them from the CDD system. Verification of compliance shall be by testing in accordance with sections 16.1 and 16.2 of this standard of this specification.

7.10.1 *Steel Cable Rescue Line*—Each steel cable, wire rope rescue line shall be made of a single length of galvanized steel wire rope. The wire rope shall be of a type, which can be visually inspected and shall be subjected to the manufacturer's inspections and non-destructive tests to verify that the steel cable rescue line is acceptable for its intended use. Steel cable rescue line may be jacketed with neoprene after the rescue line has been subjected to the manufacturer's inspections and non-destructive tests.

7.10.2 *Textile Rope*—Textile rope may be used in CDD Systems from the maximum rated height of 35 m; shall be of a kern mantel construction and made of a single length and have a minimum melting point of 195°C. Verification shall be by inspection and non-destructive test.

7.10.3 *Polymer Fiber Rope*—Polymer fiber rope may be used in CDD systems from the maximum height of 35 m and shall be made from a single length. Verification shall be by inspection and non-destructive test.

7.10.4 *Webbing Rescue Line*—Webbing, used instead of rope may be used in CDD Systems from a maximum rated height of 35 m; shall be made from a single length and manufactured in accordance with the requirements of EN 1891: Sections 4.1, 4.5 and 4.6. Verification shall be by inspection and non-destructive test.

7.10.5 *Composite Rescue Line*—Composite rescue lines, which are made from, steel cable and other materials shall be made from a single length of the composite and shall be manufactured in accordance with the manufacturer's specifications and standards. The composite rescue lines shall comply with the flame and fire resistance requirements of sections 8.3, 8.3.1, 8.3.2 and 8.3.3 of this standard. Verification shall be by inspection and non-destructive test.

7.10.6 *Terminations*—Rescue lines shall be supplied with permanent terminations. All terminations shall be made so that it shall be possible to inspect them visually unless they are located inside a cable spool. Terminations shall be designed so that they can only be opened by means of a tool, reference prEN 341:2002, 4.1.4. All terminations shall have at least 90 % of the descent lines required strength. Verification shall be in accordance with the requirements of 16.11

7.11 *Descent Rails and Tracks*—Descent rails and tracks used with Class G and Class H CDD systems shall be made from stainless steel or other materials that provide corrosion resistance. Rails and tracks shall be constructed in sections that connect together in a manner that maintains alignment and provides a smooth transition from section to section.

7.11.1 *Installation Static and Dynamic Strength*—Each rail or track section shall be anchored to the building using multiple anchors. Each installed sections of descent rails and tracks shall provide the static and dynamic strength required by sections 9.2 and 9.4 of this standard. Testing shall be in accordance with sections 16.1 and 16.2.

8. Physical Properties

8.1 *General Design Requirements*—CDD systems shall be designed so that they ~~may remain~~ are capable of remaining in place, stored or installed, inside or outside high-rise multi-story buildings for a minimum of 10 years when the periodic inspections and maintenance are conducted in accordance with the manufacturer's requirements and procedures, in accordance with ~~section 7.2~~ through 7.2.2.

8.1.1 *Design*—The Basic concepts and general principles of design contained in EN 292-1:1991 shall be used during the design process. Anchors and escape openings that are determined to be necessary shall be installed and all preparations made so the CDD Systems are continually ready for use. CDD Systems may be designed in a variety of configurations to satisfy the applicable requirements of this standard. Systems may employ mounted or anchored CDDs with descending rescue lines, anchored rescue lines with descending CDDs which the rescue line passes through or from which the rescue line is dispensed, or CDDs that descend on pre-installed rails or tracks.

8.1.2 *Rescue Harness Use*—All CDD System designs require that people using the CDD must wear a rescue harnesses required by this standard or special rescue harnesses for children or invalids that are selected by the manufacturer, reference sections 9.6 through 9.6.3. The harness may be attached to a rescue line, to a CDD, which dispenses the rescue line, or to a CDD that descends on a rail or a track.

8.1.3 *Packaged Ready for Use*—CDD systems may be packaged to include ancillary components that are necessary to provide a complete system that is ready for use. Verification shall be by inspection and review of the manufacturer's documents.

8.2 *Hazard and Risk*—The manufacturer of each CDD System, or their authorized representative shall accomplish a hazard and risk analysis for each CDD installation, in accordance with the requirements of ~~sections 8.2.1 through 8.2.4.2~~. The CDD system manufacturer or their representative shall advise the purchaser and those intending to use the CDD systems of the hazards and risks associated with their use during emergency situations.

8.2.1 *Falling Debris*—When fire or other events are occurring above the evacuating person falling debris may present a hazard during evacuation.

8.2.2 *Human Tenability Analysis*—A human tenability analysis that considers high temperature, smoke and other products of combustion shall be conducted by the CDD system manufacturer. The manufacturer or their representative shall utilize the