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Standard Specification for High-Rise Building External Evacuation Controlled Descent Devices[1]

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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 Building External Evacuation Controlled Descent Device (CDD) systems for emergency escape of persons who cannot use the standard exit facilities in high-rise 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 Components[3]

ANSI/AWS D, 14.4 Specification for Welded Joints in machinery and Equipment[3]

2.3 *ASCE Standard:*

ASCE 1-05 Minimum Design Loads for Buildings and Other Structures[4]

2.4 *ASME Standard:*

ASME A120 Safety Requirements for Powered Platforms for Building Maintenance[5]

2.5 *International Standards:*

CSA-Z259.10 Full Body Harness, M90[6]

CSA-Z259.2.3-99 Descent Control Devices[6]

EN 292-1:1991 Basic Design Concepts and general Principles of Design for Safety Machinery[7]

EN 362 Connectors and Attachment Hardware[7]

EN 1497 Rescue Equipment-Rescue Harness[7]

EN 1498 Rescue Equipment Class B-Rescue Harness[7]

EN 1891 Personal Protective Equipment[7]

PrEN 341:2002 Personal Protective Equipment for Protection Against Falls from Height[7]

2.6 *ISO Standards:*

ISO 9002 Quality Management and Manufacturing Quality Assurance[8]

ISO 10333-5 Connectors and Attachment Hardware[8]

2.7 *NEMA Standard:*

NEMA 250 Enclosures for Electrical Equipment[9]

[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.

[8] Available from International Organization for Standardization (ISO), 1 rue de Varembé, 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.

2.8 *NFPA Standard:*
NFPA 130 Appendix B 2.1.1 and B 2.1.2[10]
2.9 *OSHA Document:*
OSHA Safety and Health Bulletin, SHIB 02-24-2004 Suspension Trauma/Orthostatic Intolerance[11]
2.10 *UL Standard:*
UL 1523 Controlled Descent Devices for Marine Use, 9, 15, 16, 17 and 18[12]

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

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

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

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

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

3.2.14 *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 *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 *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 *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 *free fall*—uncontrolled descent.

3.2.18 *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.

[10] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, http://www.nfpa.org.
[11] Available from Occupational Safety and Health Administration (OSHA), 200 Constitution Ave., NW, Washington, DC 20210, http://www.osha.gov.
[12] Available from Underwriters Laboratories (UL), 333 Pfingsten Rd., Northbrook, IL 60062-2096, http://www.ul.com.

3.2.19 *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 *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 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 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 building business tenants; for their employees and high-rise 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.

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

6.2 *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.

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.

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°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°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.

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 in place, stored or installed, inside or outside high-rise 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.

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 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 evens 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 tenability requirements cited in NFPA 130, Annex B2.1.1 or BSi 7974-6, Annex G, Tables G-2 and G-3 or other standards and technical resources that contain relevant human tenability information. The manufacturer may use the referenced standards and other technical resources that are available now, or become available in the future, to analyze the tenability of people using their specific CDD systems under the conditions specified in section 8.3 of this standard.

8.2.3 *Suspended Trauma Syndrome*—Suspension in some rescue harnesses may result in Suspended Trauma Syndrome if the individual's legs are kept absolutely motionless during suspension, unless the person moves their legs during descent or uses special rescue harnesses. The CDD system manufacturer or their representative shall provide specific instruction or special harnesses to reduce this risk to an acceptable level.

8.2.4 *Installation site Hazard and Safety Analysis*—The manufacturer or his representative shall conduct a hazard and safety analysis of each CDD system installation site. Hazards such as set backs, obstructions, power lines, obstacles at the landing site and other hazards to the rescue shall be identified and avoided to the extent possible in the selection of the installation site and the evacuation route.

8.2.4.1 *Installation Site Inspection*—Site inspections shall be conducted, by the manufacturer or their representative to verify that the selected evacuation route is safe, determine the exact location for the installation of anchors and mounts, verify the accessibility of the CDD system, determine whether a special evacuation opening must be installed to provide access to the outside of the building and to determine if shields are required to prevent rescue line abrasion on building structures, during use. Safe and ready access to the CDD system shall be verified by inspection, conducted by the manufacturer or their representative. The safety analysis shall determine whether procedures exist to prevent or discourage the use of special access openings and CDD systems when there is no evacuation emergency and if they don't exist the manufacturer's representative shall recommend that they be created.

8.2.4.2 *Installation Height*—The hazard and safety analysis shall address those hazards unique to the height of use at each CDD system installation site. Predicted potential wind velocity, in the geographic region where the installation is made, and the time of exposure to the hazards identified in sections 8.2.1 through 8.2.4 shall be included in this analysis as they relate to each specific installation and to the specific characteristics of the manufacturer's CDD system. The projected area of wind loading for one person shall be assumed to be 0.7 m^2 and the wind load shall be calculated based on the force of 7.3 N/m^2 multiplied by the wind velocity in km/h, Reference the applicable sections of ASCE 7-05 or ASME A120.

8.3 *Flame and Fire Resistance*—CDD Systems including rescue lines, rail, tracks and all component parts of the system shall be resistant to the temperatures resulting from exposure to flame and fire and shall provide safe operation during and after exposure in accordance with the requirements of sections 8.3.1 through 8.3.3.1.

8.3.1 *Fixed CDD Systems, Anchors, Rails and Tracks*—Anchored CDDs, their anchors and the anchors used with CDD Systems that employ rails or tracks, shall be capable of safe operation during and after exposure to 200°C for a period of time equal to the longest descent time based on the maximum rated height and the rate of descent, for each CDD System design. The longest descent time shall be defined by the manufacturer and clearly marked on each CDD. Flame exposure testing shall be performed in accordance with section 16.9.1.

8.3.2 *Anchored Rescue Lines*—Segments of rescue lines, used with descending CDDs shall be capable of safe use during and after exposure to 300°C for a period of time equal to 60 % of the longest descent time based on the maximum rated height and the rate of descent. The longest descent time shall be defined by the manufacturer and clearly marked on each CDD. Testing shall be performed in accordance with section 16.9.2.

8.3.3 *Descending Rescue Lines, Non-Metallic Parts and Components*—Descending rescue lines, and external non-metallic components which descend during rescue shall be protected from, or independently capable of, withstanding exposure to 300°C, for a period of time equal to the longest time it takes for the CDD to descend through 2.5 m of exposure to this temperature as defined by the manufacturer and confirmed by test results. Testing shall be in accordance with Section 16.

8.3.3.1 *Class A and B Rescue Lines and Non-Metallic Parts*—Descending rescue lines that are retrieved for repetitive rescue descents shall be protected from, or independently capable of, withstanding exposure to 300°C, for a period of time equal to the longest time it takes to be retrieved a distance of 2.5 m. The manufacturer shall define this time period.

8.4 *Protection from Insects, Rodents and Birds*—CDD systems, component parts and enclosures shall be designed to prevent damage, degradation or interference with operation resulting from contamination, obstruction or the presence of insects, rodents and birds. Verification shall be by inspection.

8.5 *Electrical Energy*—CDD systems that use electrical energy may use building power sources when they are available and shall provide an independent electrical power source, for use when building power is not available. All electrical equipment and wiring shall comply with all applicable codes at the location of the installation. Verification shall be by inspection and review of the manufactures technical documents.

8.5.1 *Grade 1 and Grade 3 CDD Systems*—Grade 1 and Grade 3 CDD Systems that use electrical components and are installed in protected areas shall be designed in accordance with the requirements of NEMA 250. Verification shall be by inspection and review of the manufacturers test data to confirm compliance with the requirements of NEMA 250 and testing in accordance with section 16.6.

8.5.2 *Grade 2 CDD Systems*—Grade 2 CDD Systems that use electrical components and are installed in unprotected areas shall be designed to insure that the electrical parts are protected and shall be designed in accordance with the minimum rating of NEMA 250. Verification shall be by inspection and review of the manufacturers test data to confirm compliance to the requirements of NEMA 250 and testing in accordance with section 16.6.

8.6 *Thermal Safety Design*—The thermal design of CDD Systems shall be such that the temperature rise of any part of the equipment during its use shall not create a burn hazard to people, nor adversely affect the operation of the equipment.

8.6.1 *Maximum Temperature Rise During Use*—None of the components of CDD Systems that normally come in contact with people shall develop a temperature higher than 48°C. during use, reference prEN 341:2002, 4.8.1. The maximum temperature of any accessible surface of the CDD or any part of the CDD system shall not exceed 65°C. Verification shall be accomplished during testing in accordance with section 16.3, Descent Energy and Endurance Test.

8.7 *Total Descent Energy Dissipation Requirements*—All CDD Systems shall be capable of dissipating the total descent energy based on their Class and maximum rated height without

affecting performance or safety, reference 3.2.14. The manufacture shall specify the maximum rated height for the Class of their specific CDD system and perform the required testing in compliance with the requirement of sections 8.7.1 through 8.7.10. The CDD system may then be used at any height less than the specified maximum height of the CDD, to which it was tested. The manufacturer shall clearly mark each CDD to indicate the maximum height at which it may be used. Verification shall be by testing in accordance with section 16.3 Descent Energy, Temperature Rise and Endurance test.

8.7.1 *Class A Descent Energy*—Testing for total descent energy dissipation capability shall be done using the average load of 90 ± 1 kg and 100 repetitive descents. The calculation of the total descent energy that must be dissipated by Class A CDD systems shall be made using the simplified formula; Descent energy W = 883 J/m × the manufacturers specified height in m × 100. Verification shall be by testing in accordance with the requirements of section 16.3.

8.7.2 *Class B Descent Energy*—Testing for total descent energy dissipation capability shall be done using the averaged load of 135 ± 1 kg and 100 repetitive descents. The calculation of the total descent energy that must be dissipated by Class B CDD systems, shall be made using the simplified formula; Descent energy W = 1335 J/m × the manufacturers specified height in m × 100. Verification shall be by testing in accordance with the requirements of section 16.3.

8.7.3 *Class C Descent Energy*—Testing of total descent energy dissipation capability shall be done using a 135 ± 1 kg load. The total descent energy that must be dissipated by class C CDD systems shall be calculated using the simplified formula; Descent energy W = 1335 J/m × the manufacturers specified height in m × 1. Verification shall be by testing in accordance with the requirements of section 16.3.

8.7.4 *Class D Descent Energy*—Testing of total descent energy dissipation capability shall be done using an 180 ± 1 kg load. The descent energy that must be dissipated by class D CDD systems shall be calculated using the simplified formula; Descent energy W = 1766 J/m × the manufacturers specified height in m × 1. Verification shall be by testing in accordance with the requirements of section 16.3.

8.7.5 *Class E Descent Energy*—Testing of descent energy dissipation capability shall be done using a 135 ± 1 kg load. The descent energy that must be dissipated by Class E CDD systems shall be calculated using with the simplified formula; Descent energy W = 1335 J/m + (the average weight of the CDD in kg × 9.81 m/s^2) × the manufacturers specified height in m × 1. Verification shall be by testing in accordance with the requirements of section 16.3.

8.7.6 *Class F Descent Energy*—Testing of descent energy dissipation capability shall be done using an 180 ± 1 kg load. The total descent energy that must be dissipated shall be calculated using the simplified formula; W = 1766 J/m + (the average weight of the CDD in kg × 9.81 m/s^2) × the manufacturers specified height in m × 1. Verification shall be by testing in accordance with the requirements of section 16.3.

8.7.7 *Class G Descent Energy*—Testing of descent energy capability shall be done using a 135 ± 1 kg test weight. The total descent energy dissipation requirement of each CDD used on a Class G CDD system shall be calculated in accordance with the simplified formula; Descent energy W = 1335 J/m + (the average weight of the CDD, in kg × 9.81 m/s^2) × the manufacturers specified height in m × 1. Verification shall be by testing in accordance with the requirements of section 16.3.

8.7.8 *Class H Descent Energy*—Testing of descent energy capability shall be done using an 180 ± 1 kg test weight. The total descent energy dissipation requirement for each CDD, used on a Class H CDD systems, shall be calculated in accordance with the simplified formula; Descent energy W = 1766 J/m + (weight of the CDD, in kg × 9.81) × the manufacturers specified height in m × 1. Verification shall be by testing in accordance with the requirements of section 16.3.

8.7.9 *Class I Descent Energy*—The total descent energy dissipation for Class I CDD systems shall be limited to a maximum of 46 725 J. The total descent energy dissipation requirement for each CDD, used on a Class I CDD system, shall be calculated in accordance with the simplified formula; Descent energy W = 1335 × the manufacturer's specified height in m × 1. The maximum height for Class I CDD systems shall be 35 m. Verification shall be by testing in accordance with section 16.3.

8.7.10 *Class J Descent Energy*—The total descent energy dissipation for Class J CDD systems shall be limited to a maximum of 62 160 J. The total descent energy dissipation requirement for each CDD, used on a Class J CDD system, shall be calculated in accordance with the simplified formula; Descent energy W = 1776 × the manufacturer's specified height in m × 1. The maximum height for Class J CDD systems shall be 35 m. Verification shall be by testing in accordance with section 16.3.

9. Mechanical Properties

9.1 *Descent Control Components*—CDD systems may use hydraulic, pneumatic, electromagnetic, aerodynamic, friction, other mechanisms or combinations of mechanisms to control the descent. Manufacturers of CDD systems shall specify these mechanisms to comply with the performance capability necessary to satisfy the requirements of this standard. These mechanisms may be designed and produced by the CDD manufacturer or purchased from other manufacturers. Verification of compliance shall be by inspection and review of the manufacturer's documents followed by testing in accordance with the requirements of Section 16.

9.2 *Dynamic Strength of Load Bearing Components*—All load bearing components of CDD systems, including the CDD, the rescue line, the rail or track and all associated attachment hardware, the harness and harness connection hardware and the mounts and anchors, shall have the dynamic strength necessary to withstand the peak impact that results when a 135 kg person or test weight free falls a distance of 0.6 m. Verification shall be by testing in accordance with section 16.2.

9.3 *Static Strength of CDD Systems That Use Rescue Lines*—All load bearing components of the CDD System, including the CDD, the rescue line, the harness, harness connection hardware and all mounts and anchors shall meet the specified static strength requirements, based on class and type (see Table 2).

TABLE 2 Static Strength of CDD Systems Using Rescue Lines

Class	Type I	Type II	Type III	Type IV
A	12 kN	9 kN	N/A	N/A
B	15 kN	12 kN	N/A	N/A
C	8 kN	6 kN	N/A	N/A
D	12 kN	9 kN	N/A	N/A
E	8 kN	6 kN	16 kN	8 kN
F	12 kN	9 kN	24 kN	9 kN
I	7 kN	5 kN	14 kN	5 kN
J	10.5 kN	8 kN	21 kN	8 kN

9.4 *Static Strength of Anchored Rail and Track CDD Systems*—All of the load bearing components of CDD systems, that employ rails or tracks and all anchors, shall meet the following static strength requirements based on Class and Type. Installed descent rails and descent tracks shall provide the static strengths that result from multiplying the specified static strength of one CDD by the number of CDDs that can simultaneously occupy one section of the rail or track, determined by the following formula:

$$P = \frac{L}{L_c} \quad (1)$$

where:

P = the number of CDDs produced by a manufacturer that can occupy one section of rail or track produced by that manufacturer,

L = the length of the rail or track section produced by the manufacturer, and

L_c = the length of the CDD produced by the same manufacturer for use on that rail or track.

9.4.1 The specified static strength for one Class G CDD and the specified static strength of one Class H CDD by Type are shown in Table 3.

9.4.2 *Static Strength Determination*—The Static strength required for one CDD shall be multiplied by the total number of CDDs that may occupy one section of rail or track when calculated using the above formula to determine the total static strength requirement.

9.5 *Rescue Lines*—Rescue lines, used with CDD Systems shall comply with the requirements of section 7.10 of this standard. The manufacturer shall provide all rescue lines that are integral components of CDD systems with all terminations made. Each rescue line shall be 5 % longer than the rated height of the CDD System with which it will be employed. The connection of a fully extended rescue line, attached to a fully unwound drum, shall be capable of holding a 400 kg static load. Verification shall be by inspection and testing in accordance with Section 16.

9.6 *Rescue Harness*—Rescue harnesses shall be selected for their suitability for application with CDD Systems and for their ease and speed of use.

9.6.1 *Separate Item Rescue Harness*—CDD Systems that use separate item rescue harnesses shall use those certified to the requirements of, EN 1497, EN 1498, or CSA-Z259.10. Verification shall be by inspection and review of the manufacturer's documents.

9.6.2 *Special Rescue Harnesses*—Harnesses and slings, designed for special groups of people, including, but not limited to the disabled, physically impaired, injured persons, and children, shall be selected for use by the manufacturer and prescribed to the purchaser, as needed. Verification of the suitability and strength of such harnesses shall be accomplished by the CDD system manufacturer by analysis or review of vendor test and certification documents.

9.6.3 *Integral Rescue Harness*—Rescue harnesses, which are integral parts of a CDD, shall be easy to use and provide support to the pelvic and torso regions. The integral rescue harnesses shall be attached to the CDD so that does not permit removal without the use of a tool. The minimum breaking strength of all component parts of all integral rescue harnesses shall be in accordance with Tables 2 and 3, based on the CDD system Type and Class, reference CSA-Z259.10. Verification shall be by testing of the CDD in accordance with 16.1 and 16.2.

9.7 *CDD Connectors*—D rings, carabineers and other connectors used to attach the rescue harness to the rescue line and any special hardware used to attach the CDD directly to the rescue harness and to the rescue line or to rails or tracks, shall satisfy the static and dynamic load requirements of sections 9.2, 9.3 and 9.4 of this standard.

9.8 *Anchors and Mounting*—Anchors and mounting for CDD Systems and their components shall be made using commonly accepted practices and in accordance with the designs and installation instructions provided by the manufacturer. The anchorages and mountings shall be made and analyzed or tested by the installer in accordance with the requirements of either Test Methods E 488, E 2265, E 1512, or E 894.

9.8.1 *Dynamic and Static Strength Verification*—All CDD system anchors shall be capable of providing the dynamic and static strengths required by sections 9.2, 9.3 and 9.4 of this standard. Each mount and each anchor designed by the manufacturer shall be subjected to a design analysis, performed by the manufacturer and reviewed by the certification test authority. Verification testing shall be conducted in accordance with the requirements of sections 16.1 and 16.2; in addition, all installed anchors and mounts shall be analyzed or tested by the installer to verify the required static and dynamic load capability.

9.8.2 *Building Construction*—The CDD system installer shall review the details of the buildings construction using drawings and other available sources of information, to locate concrete flooring, steel girders or other structural members, in order to accomplish the installation in accordance with the manufacturer's anchor or mounting design and instructions. The installer shall be trained and authorized by the manufacturer, reference Terminology E 631.

9.8.3 *Anchors and Mounts on Rigid Structures*—When CDD systems or their components parts are attached to structures having high rigidity, such as concrete or metal the

TABLE 3 Static Strength Anchored Rails or Tracks

Class	Type I	Type II	Type III	Type IV
G	P × 8 kN	P × 6 kN	P × 8 kN	P × 6 kN
H	P × 12 kN	P × 9 kN	P × 12 kN	P × 9 kN

stresses within the anchor points, the imposed force on the structure the installation shall be analyzed using the following formula:

$$Fv + Sd \times MRL \quad (2)$$

where:
Fv = imposed force on the structure,
MRL = maximum descent load, and
Sd = 3 or the actual dynamic load factor.

9.8.4 *Special Anchors*—CDD systems that utilize a single anchor to support multiple simultaneous descents shall meet the following static strength requirement. The static strength of the anchor *S*, in kN is determined by the formula: $S = [6.67 + 1.33\ n]$ kN, where *n* is the maximum number of descending persons the anchor is required to support. The calculation to determine the strength of special anchors is based on the static strength requirement of one person from the Table 2 plus the static load of all other descending persons using CDDs at their maximum rated load, which could share the common anchor.

9.9 *Manual Control Force*—The maximum force that must be applied by a person controlling the descent of manually controlled CDD, shall be no more than 120 N, reference prEN 341:2002, 4.2. Verification shall be by testing in accordance with 16.4.

9.10 *Maximum Rated Load*—CDD systems shall operate safely and within all performance parameters with the maximum rated load. The maximum rated load for all CDD systems designed to rescue one person per descent is 135 kg. The maximum rated load for all CDD systems designed to rescue two persons per descent is 180 kg.

9.11 *Overload*—The rate of descent of all CDD Systems shall operate safely with an overload but are required to remain within the rate of descent requirements of sections 10.1 and 10.2 of this standard. The overload weight for all CDD systems designed to rescue one person per descent shall be 165 kg. The overload weight for all CDD systems designed to rescue two people per descent shall be 220 kg.

9.12 *Minimum Rated Load*—All CDD systems shall operate safely and within all performance parameters with the minimum rated load of 30 kg.

9.13 *Maximum Rated Height*—CDD Systems shall operate safely from the maximum rated heights that are specified by the manufacturer for their specific Class of CDD system. Verification shall be by testing in accordance with section 16.4, Descent Energy, Temperature Rise and Endurance Test. The manufacturer shall clearly mark each CDD, with its maximum rated height.

9.14 *Design for Wind Loading*—All components and parts of CDD systems that mount on the outside of buildings shall be designed to withstand the wind loading resulting from winds of 151 km/h and the resultant force of 1100 N/m^2, reference the applicable sections of ASCE 7-05 or ASME A120. Verification of compliance shall be by analysis of the manufactures CDD system design.

10. Performance Requirements

10.1 *Maximum Average Rate of Descent*—The average steady state rate of descent of all CDD Systems, with the rated weight, shall not exceed 2.0 m/s. The average steady state rate of descent, for CDD systems under overload conditions, shall not exceed 2.2 m/s. Verification shall be by testing in accordance with 16.4.

10.2 *Minimum Average Rate of Descent*—The average steady state rate of descent for all CDD systems, except Classes I and J, shall be no less than 0.25 m/s. The average steady state rate of descent for Classes I and J, shall be no less than 0.125 m/s. Type III and IV CDD systems may be manually controlled to slow or stop the descent, however; the average steady state rate of descent, when the manual override is released, shall be no less than the minimum average steady state rate of descent for its Class.

10.3 *Rewind Rate*—The velocity of the rescue line, during rewind, shall not exceed 4 m/s. Verification shall made be by testing.

10.4 *Free-Fall*—CDD systems shall be designed to minimize the possibility of free-fall and the effects of free-fall on CDD systems and people using them.

10.4.1 *Design for Free-Fall*—CDD Systems, rescue lines, harness attachments and anchorage installation shall be designed to limit the free-fall distances at the beginning of a descent to 0.6 m and to withstand the impact load that results when a 135 kg person, free falls a distance of 0.6 m. In addition to the CDD system design, the manufacturer shall provide procedures and make provisions to reduce or eliminate slack in rescue lines, prior to the initiation of a descent. Verification shall be by testing in accordance with 16.2.

10.4.2 *Free-Fall Impact Reduction*—CDD Systems may incorporate a force limiter to reduce the impact of a free-fall. CDD systems employing a force limiter shall limit the peak dynamic load on the load bearing components of the system , including the CDD, the rescue line the rail or track and associated attachment hardware, the harness and the harness connecting hardware and the mounts and anchors to 3 kN. The deceleration distance necessary to reduce the rate of descent to 2 m/s shall be limited to 2 m after the CDD has engaged, following a 0.6 m free-fall, with a 135 kg test load. Verification shall be by testing in accordance with 16.2. CDD systems may incorporate force limiters to reduce the impact of free-fall.

10.5 *Elevated Operating Temperature Exposure*—CDD systems shall be capable of operating safely, after exposure to a temperature of 80 ± 2°C, for a minimum of 8 h. Verification shall be by conditioning, in accordance with 14.1, followed by testing in accordance with 16.4.

10.6 *Weather Conditions*—CDD Systems shall be capable of safe operation under conditions of rain, sleet, hail, snow and ice. The person intending to use the system shall remove ice and snow from the CDD system, prior to use. Verification of the CDD system capability, under these conditions, shall be accomplished by conditioning the CDD system, in accordance with 14.2, 14.3, 14.4, and 14.5 followed by testing in accordance with 16.4.

11. Workmanship, Finish and Appearance

11.1 CDD systems shall be manufactured to comply with this standard in an ISO 9000 certified or an equivalent manufacturing organizational structure to provide an acceptable level of reliability and quality control. Workmanship, finish and appearance shall be in compliance with this standard

and accordance with the manufacturers design and documented production requirements. Verification shall be by inspection and review of the manufacturer's documents.

12. Test Samples

12.1 *Number of Test Samples*—A minimum of three test samples shall be conditioned and tested, prior to certification testing. The rescue line or sections of the rail or track supplied by the manufacturer shall be conditioned and tested as an integral part of the CDD system. Each test sample shall be new.

12.2 *Test Sample Conditioning*—CDD systems and component parts selected for testing shall be conditioned, as required, by Section 14.

13. Test Methods

13.1 *Scope*—This section describes the inspection and testing requirements for all CDD system designs. Each CDD system shall be examined for compliance with the requirements specified by this standard. The manufacturer's technical drawings and other documents shall be used, in addition to the required testing, to confirm compliance of the design to the requirements of this standard.

13.1.1 *Inspection and Test Requirements*—The inspection and tests shall include the requirements of Section 16. The scope of testing to be accomplished includes the verification of the mechanical, physical and performance and operating parameter for CDD systems.

13.1.2 *Design Verification and Testing*—The design verification tests must be successfully completed by an independent, internationally recognized test organization in order for a CDD system design to be certified in accordance with this standard. The compliance of CDD systems to this standard shall be verified by inspections and tests. The specific parameters, required by this standard, shall be verified using test methods and procedures defined in existing standards for similar equipment, whenever possible.

13.2 *Certification Test Samples*—Three samples of each CDD system design shall be selected to facilitate design verification testing. Each sample submitted for test shall be manufactured using the new materials and processes identical to those used in production of the CDD system. The three samples to be used for certification testing shall be conditioned prior to testing.

13.3 *Acceptance or Rejection*—One failure of the CDD system or a component part of the system to meet the requirements of any part of the certification testing procedure shall constitute a failure of the CDD system to meet the requirements of this standard and shall result in rejection.

13.4 *Production Item Testing*—Production testing of CDD systems and their component parts shall be accomplished in accordance with each manufacturers documented test plans and procedures prior to delivery. 100 % of production CDD systems shall be tested to verify all features that affect safety of use. The minimum production functional testing shall be one cycle of each test in accordance with 16.2, 16.4. Manufactures may, at their discretion, include sample conditioning and testing of specific parameters or components to verify the continuing quality and reliability of the CDD. Production test data shall be recorded and retained by the manufacturer.

13.5 *Production Test Sample Preparation*—Production test specimen preparation shall be conducted in accordance with the manufacturers documented requirements and procedures.

13.6 *Inspection and Test after Installation*—All CDD systems shall be inspected after installation to verify the accessibility of the CDD system and a clear route for evacuation. All anchors and mounts shall be analyzed as installed by the manufacturer or their representative to verify that they provide the required load bearing capability.

13.7 *Re-Certification Inspection and Test*—All CDDs that have been damaged or used shall be inspected and repaired, when necessary, by the manufacturer or their representative. Re-certification of CDDs in which the descent control mechanism, or any component of that mechanism, has been refurbished or repaired shall include testing in accordance with the requirements of section 13.4. Each repaired, refurbished, retested and recertified CDD system shall be clearly marked "re-certified" by the manufacturer or their representative.

14. Certification Test Sample Conditioning

14.1 *Test Samples*—CDD system test samples shall be conditioned, as required, prior to testing, in accordance with the requirement of sections 14.2 through 14.7.

14.2 *Elevated Temperature Conditioning*—The CDD system and its rescue line, and a test sample section of its track or rail shall be conditioned at a temperature of 80 ± 2°C for a minimum of 8 h.

14.3 *Wet Conditioning*:

14.3.1 *Grade 1 and 3*—Grade 1 CDD systems and their rescue lines, and a test sample section of rails or tracks and all other components of Grade 3 CDD Systems that are designed for installation or storage out side of a building shall be immersed in water at 20 ± 2°C for a minimum of 8 h.

14.3.2 *Grade 2 and 3*—Grade 2 CDDs and their rescue lines and a test sample of Grade 3 system components that are designed for storage inside a building shall be subjected to water spray conditioning using the methods of UL 1523, 15, water spray test.

14.4 *Cold Conditioning*:

14.4.1 *Grade 1 and 3*—Grade 1 CDD systems and their rescue lines and, Grade 3 CDD system components that are designed for installation or storage on the outside of buildings including a test sample section of the rails or tracks, shall be conditioned at –35 ± 2°C for a minimum of 8 h.

14.4.2 *Grade 2 and 3*—Grade 2 CDD systems, their rescue lines and component parts of Grade 3 CDD systems, designed for installation or storage in side a building, shall be conditioned at –20 ± 2°C for a minimum of 4 h.

14.5 *Wet and Cold Conditioning*—Grade 1 and Grade 3 CDD systems and their rescue lines or system components that are designed for installation or storage outside of a building, including test sample sections of rails or tracks, shall be wet conditioned in accordance with section 14.3. After wet conditioning, excess water shall be allowed to drain from the test sample for a maximum of 15 min. The sample shall then be subjected to a temperature of –35 ± 2°C for a minimum of 8 h.

14.6 *Salt Spray Conditioning*:

CDD systems shall be subjected to the salt spray conditioning required by section 14.6.1 or 14.6.2.

14.6.1 *Grade 1 and 3*—Grade 1 CDD systems test samples and components of Grade 3 CDD systems, that are designed for installation or storage on the outside of buildings, including a test sample section of the rail and track of Grade 3 systems, shall show no evidence of corrosion that could affect their function or safety after salt spray, (fog) conditioning using the methods of Practice B 117. The exposure to the salt spray shall be for 6 weeks. Verification shall be by inspection.

14.6.2 *Grade 2 and 3*—All exposed components of Grade 2 and Grade 3 CDD systems, and all exposed component test samples, shall show no evidence of corrosion that could affect their function after salt spray, (fog) conditioning, using the test methods of Practice B 117, for two periods of 24 h each followed by 1 h of drying time. Verification shall be by inspection.

14.7 *Water and Ultraviolet Light Exposure*—Grade 1 CDD System test samples and test sample sections of Grade 3 system component parts, that install outside the building including sections of rails and tracks, shall be exposed to ultraviolet light and water in accordance with method 1 of the Standard Practice of Light Exposure Apparatus, (Carbon Arc Type), with and without water for exposure of nonmetallic materials, using the methods of Practice G 23, and the apparatus designated Type D or DH of Practice G 23. During each 20-min period the test specimen shall be exposed to ultraviolet light from the carbon arcs for 17 min and to the ultraviolet light and water spray for 3 min. The conditioning shall be continuous for a period of 1000 h. Evaluation shall be by inspection.

15. Test Equipment

15.1 *Calibration*—Test measurement equipment and instruments shall be calibrated against national standards, in accordance with the quality assurance requirements of ISO 9000. Test methods, including test fixtures that are defined in existing standards, shall be used to facilitate testing. Modifications to the test fixtures, defined in existing standards, or the use of similar/equivalent test fixtures shall be allowed.

15.2 *Test Weights*—The weights used to provide the loads used in testing shall have a mass of 30 ± 1 kg, 90 ± 1 kg, 135 ± 1 kg, 150 ± 1 kg, 180 ± 1 kg and 200 ± 1 kg and shall be constructed of steel or other rigid material. The weights may be designed for connection to the end of a rescue line or designed to fit into a rescue harness.

15.3 *Quick Release Mechanism*—A quick release mechanism shall provide the capability to release the test weight without imparting any motion to it. The release mechanism shall be capable of remote operation, reference CSA Z259.2.3-99, Section 6.3.3.

15.4 *Force Measurement Instrumentation*—The force measurement equipment shall be capable of measuring the forces required by this standard, to ±2 % with a minimum sampling rate of 1000 Hz and a frequency response up to a 3 dB down corner of at least 100 Hz with a cutoff frequency, no greater than 400 Hz.

16. Test Procedures

16.1 *Static Strength Tests*—Test Samples of CDD systems that employ rescue lines shall be anchored on a rigid structure; the rescue line shall be prevented from movement and held in place in the CDD. CDDs that are used on rails or tracks shall be locked in position on an anchored test sample section of the rail or track to prevent descent. The Test methods of CSA Z259.2.3-99, 6.4.2.1 shall be used to perform this test.

16.1.1 *Static Loads and Their Attachment*—The Static loads required by section 9.3 and 9.4 based on Type and Class shall be verified, with all load bearing components of the CDD system connected, from the harness through the anchor. The specified static load shall be attached to each CDD system test sample at the normal load attachment point, for each design.

16.1.2 *Load Suspension Test and Inspection*—The load shall be suspended for a period of 10 min. No damage to any part of the CDD system, the anchor, the rail or track shall result, verified by inspection.

16.1.3 *Additional Testing Requirements*—CDD systems shall be subjected to the rate of descent test of section 16.4 to verify normal operation after the tests of section 16.1 have been completed. The static resistance test required by section 16.1 shall be conducted before the Descent Energy, Temperature Rise and Endurance Test, of section 16.3.

16.2 *Dynamic Strength and Deceleration Test*—Dynamic strength and deceleration testing of all CDD systems that do not employ force limiters shall be conducted using the test methods of CSA 259.2.3-99, 6.3.1.

16.2.1 *Force Limiter Testing*—Dynamic strength and deceleration testing of all CDD systems that employ force limiters shall be conducted using the test methods of ANSI Z359.1-1992, Section 4.3.7.2. The test weight shall be affixed to the harness of CDD systems that use integral rescue harnesses. The resulting rescue line force, or the resulting force applied to a test sample section of rail or track, shall be no greater than 3kN during deceleration. The rate of descent shall be no more than 2 m/s after the impact force from the free fall has been absorbed. The distance traveled by the test weight shall be no more than 2 m, during the period of deceleration to 2 m/s.

16.2.2 *Rate of Descent Testing*—The rate of descent test shall be conducted in accordance with section 16.4 to verify proper performance of the CDD, after this test. The dynamic strength and deceleration test shall not cause any damage to the CDD or, of the system component parts, including rails and tracks, verified by inspection.

16.3 *Descent Energy, Temperature Rise and Endurance Test*—Testing shall be conducted using the test methods of prEN 341:2002 (E), Section 5.7, to verify the specified parameters of this standard. The rescue line rotation direction, within the CDD, shall be as indicated by the manufacturer for normal use.

16.3.1 *Descent Energy Testing*—Descent energy testing shall be conducted in accordance with the requirements of the Class of the CDD system, under test. The specified maximum rated height, and weight, in accordance with the requirements of section 8.7 of this standard shall be used during this testing. The number of test descents conducted, during certification testing for Classes A and B shall be 100 from the rated height

and the number of test descents from the rated height for all other Classes shall be 1.

16.3.2 *Temperature Rise Testing*—The temperature rise of the CDD system shall not exceed 45°C on any accessible surface and shall not exceed 65°C on any exposed part of the CDD system in accordance with the requirements of 8.6.1.

16.3.3 *Descent Energy Testing*—Descent energy testing may be conducted from the specific rated height, or may be conducted from lower heights by employing an increased number of operating cycles to produce the same total descent energy required. The Descent energy test may be accomplished using a mechanical simulator, fixture or device that is designed by the testing authority, based on and consistent with the requirements of prEN 341:2002 (E), Section 5. 7 and Appendix X2.

16.4 *Rate of Descent Test*—The average steady state rate of descent shall be measured using the test methods of prEN 341:2002 (E), Sections 4.8.2 and 4.8.3. This test may be performed using a test bench, test tower or other test fixtures.

16.4.1 *Test Equipment Design*—This test equipment may be designed by the test authority based on the definitions and requirements of prEN 341:2002 (E).

16.4.2 *Rate of Descent Limits*—The average steady state rate of descent, with the specified test weights of the minimum and maximum rated loads for Class A, B, C, D, E, F, G, and H, shall be less than 0.25 m/s and no more than 2 m/s. The average steady state rate of descent for Classes I and J shall be less than 0.125 m/s and no more than 2 m/s.Type III and IV CDD systems shall have the maximum rate of descent of 2 m/s when the manual over ride is released. Average steady state rate of descent of any Class CDD system shall be less than 2.2 m/s when tested with the specified overload test weight. The average steady state rate of descent shall be measured during the time the descent is automatically controlled and stabilized.

16.5 *Resistance to Slippage Test*—This test applies only to CDD systems, which use a traction sheave or that have manual over ride capability and shall be performed using the test methods of CSA Z259.2.3-99, 6.4.6.3. The CDD sheave shall be manual full-stop position. Forces 3 times the rated load and at least 4 kN shall be applied to one end of the rescue line of the device and 50 N to the other end. The load shall be applied for 3 min. No slippage through the sheave shall be allowed.

16.6 *Wet Test*—The CDD and its rescue line or test sample section of the rail or track or other CDD component that is mounted on the outside of buildings shall be tested in accordance with the test methods of CSA Z259.2.3-99, 6.4.7. The wet conditioning of section 14.3 shall be done using the test methods of CSA Z259.2.3-99, 5.3. All components of CDD systems that are stored or installed inside of buildings shall be wet conditioned in accordance with UL 1523, 9. CDD systems shall be tested in accordance with section 16.4 within 5 min after wet conditioning has been completed.

16.7 *Extreme Temperature Test*—The CDD and its rescue line or test sample section of the rail or track shall be conditioned and tested as required by the test methods of CSA Z259.2.3-99, 6.4.8. The CDD shall be tested in accordance with section 16.4 within 5 min after conditioning required by sections 14.2 and 14.4. The conditioning temperatures shall those temperatures specified in sections 14.2 and 14.4.

16.8 *Wet and Cold Test*—The CDD and its rescue line or the test sample section of the rail or track or any component that is installed on the outside of the building shall be conditioned in accordance with section 14.5 and tested using the test methods of CSA Z259.2.3-99, 6.4.9. The CDD shall be tested in accordance with section 16.4 with in 5 min after the conditioning required by section 14.5 has been completed.

16.9 *Flame Exposure Test*—Flame exposure testing shall be conducted using the test methods of UL 1523; 16. The distance that the test specimen shall be placed from the heat source, to obtain the required exposure temperature, shall be calculated or determined from measurements, by the testing authority.

16.9.1 *Fixed CDD, Anchor, Rail and Track Flame Exposure Test*—One specimen of the CDD, including the rescue line and anchor, a sample section of rail or track, excluding exposed CDD parts that are non-metallic, shall be exposed to a temperature of 300°C for a period of time equal to the longest descent time for the CDD System under test. Testing shall be conducted using the methods of UL 1523, 16 to verify compliance with the requirements of section 8.3.1. Following exposure, the CDD, rescue line, rail or track shall be subjected to testing in accordance with section 16.4, Rate of Descent, for one cycle of operation with a 135 ± 1 kg test weight for Classes A, C, E, and G and I or with a 180 ± 1 kg test weight for Classes B, D, F, H, and J, followed by one descent with a 30 ± 1 kg weight.

16.9.2 *Anchored Rescue line Flame Exposure Test*—One segment of rescue line, a minimum of 1 m in length from CDD systems using anchored rescue lines, (Classes E, F, I, and J), shall be exposed to a temperature of 300°C, for a period of time equal to 60 % of the longest descent time for the CDD system under test, using the test methods of UL 1523, 16 to verify compliance with section 8.3.2. The test specimen segment shall not be separated from the complete rescue line. After exposure and with the specimen still hot, the CDD system shall be tested to verify that it still functions in accordance with the requirements of this standard with the maximum rated load, as indicated by the manufacturer.

16.9.3 *Non-metallic Components and parts Exposure Test*—Exposed non-metallic components of CDD Systems shall be tested, using the test methods of UL 1523, 16 to verify compliance with the requirements of section 8.3.3.

16.10 *Overload Test*—CDD Systems designs shall be subjected to the overload test requirements of section 9.11 of this standard, using the test methods of UL 1523, 17.

16.10.1 *Repetitive Rescue Systems, Class and A and B*—Class A CDD systems shall be tested with the overload weight of 150 ± 1 kg, Class B CDD Systems shall be tested with the overload weight of 200 ± 1 kg. All CDD systems shall be tested for 2 cycles with the required overload weight, in accordance with the requirements of section 16.4. The rate of descent shall not exceed 3 m/s under overload conditions and no other risk to persons shall result.

16.10.2 *One Time Rescue Systems*—Single rescue CDD systems shall be tested as follows: Class C, E, and I CDD systems shall be tested for 1 descent from the rated height with

a 150 ± 1 kg load and Class D, F, and J CDD systems shall be tested for one descent from the rated height with a 200 ± 1 kg load in accordance with section 16.4. The rate of descent shall not exceed 3 m/s.

16.10.3 *Multiple Rescue Systems*—Multiple rescue CDD systems shall be tested as follows: Class G CDD systems shall be tested for 1 descent from the rated height with a 150 ± 1 kg and Class H CDD Systems shall be tested for 1 descent from the rated height with a 200 ± 1 kg load in accordance with section 16.4. The rate of descent shall not exceed 3 m/s.

16.11 *Rescue Line Termination Test*—The termination on the end of the rescue line shall be tested using the test methods of prEn 341:2002 (E), Section 5.4. The termination shall not pull through the CDD drum or spool while sustaining a test force of 4 kN for 3 min. The test shall be conducted 1 time after the descent energy test has been completed.

16.12 *Rescue line Entanglement and Spooling Test*—Rescue line entanglement and spooling tests shall be preformed using the test methods of CSA Z259.2.3-99, 6.4.4 and 6.4.12. This test shall be performed one time, for repetitive Classes of CDD systems and is not required for one time use Classes of CDD systems specified in this standard.

16.12.1 *Repetitive Rescue Systems*—Classes A and B CDD systems that use rescue lines shall operate smoothly and without knots or frays in the rescue line after being subjected to 100 cycles of operation, with a 136 kg load, in accordance with section 16.3.1. The sample CDD shall be installed, (mounted), operated and re-wound if necessary in the manner intended during normal use.

16.12.2 *Single Rescue Systems*—Classes C and D CDD systems that use rescue lines shall operate smoothly and without knots or frays in the rescue line during one descent from the rated height, in accordance with section 16.3.2.

16.13 *Rescue Line Residual Static Strength Test*—The residual static strength, shall be tested using the test methods of CSA Z259.2.3-99, Sections 6.4.4.2 and 6.4.4.3, and testing in accordance with section 16.1. After the completion of all other tests, the rescue line shall retain 90 % of its original, new condition maximum strength, as specified by the rescue line manufacturer.

16.13.1 *Repetitive Rescue Systems*—One sample of Classes A and B CDD system rescue lines shall be tested to destruction after at least 10 test cycles from the rated height of the CDD, in accordance with section 16.1 to ensure that excessive thermal damage has not occurred as a result of heat transfer from the CDD to the rescue line.

16.13.2 *One Descent Rescue Systems*—One sample of Class C, D, E, and F CDD system rescue lines shall be tested to destruction after one test from the rated height of the CDD System, in accordance with section 16.1.

17. Inspection

17.1 *Inspection and Test Requirements*—The manufacturers of CDD Systems shall be ISO 9000 certified or shall demonstrate equivalent capability and organizational disciplines. All in-process production inspection and testing including the final inspection and testing of CDD systems, shall be accomplished in accordance with the manufacturers documented procedures. Further the inspection of CD installation sites is required to determine the location for mounts and anchors and to identify the evacuation route.

18. Certification

18.1 *Certification and Testing*—CDD must be reliable and provide a high degree of safety for persons using them. Certification to this standard requires the successful completion of the testing required by Section 16. Certification testing shall be conducted by an internationally recognized testing organization.

19. Product Marking

19.1 *Type Grade, Class and Serial Number*—CDD shall be clearly and permanently marked to indicate Manufacturer, Type; Grade and Class of the device, serial number and model.

19.2 *Additional Marking*—Additional marking of the product shall provide operating instructions, inspection information and precautions or warnings, if applicable and other information deemed pertinent, by the manufacturer for safe and effective use of the device.

19.3 *Marking Requirements*—Markings shall be a minimum of 3.2 mm in height, reference UL 1523, 19.

19.4 The following markings shall be placed on each CDD, reference prEN 341:2002 (E).

19.4.1 Type of CDD;

19.4.2 Grade of CDD;

19.4.3 Class of CDD;

19.4.4 Rated height, and the maximum height of use;

19.4.5 Minimum and maximum rate of descent;

19.4.6 Maximum and minimum rated load;

19.4.7 One Time Rescue CDDs shall be marked “FOR ONE TIME USE ONLY”;

19.4.8 Name and/or Logo of the manufacturer;

19.4.9 Serial Number;

19.4.10 Year of production;

19.4.11 Operating instructions;

19.4.12 Hazard Warnings; and

19.4.13 Re-certified, (if the CDD system has been re-certified).

20. Packaging and Package Marking

20.1 *Packaging Requirements*—Packaging shall be suitable to provide long shelf life and protection from environmental factors, shipping and handling. Package marking shall be in accordance with the manufacturer’s instructions. All CDD packaging shall be marked to indicate the Type, Grade and Class of the CDD and its rated maximum height of use.

21. Quality Assurance

21.1 *Quality Assurance Program*—CDD manufacturers shall maintain a system of quality control that is ISO 9000 certified or equivalent. The manufacturer’s quality control system shall be documented with methods that track the quality assurance, inspection and test of CDD, by serial number, during the manufacturing and test process.

22. Precision and Bias

22.1 *Statistical Parameters*—No testing or evaluation of the required testing has been accomplished to determine any associated statistical parameters. The repeatability of test date within the calibrated accuracy of test equipment, employed during testing shall be maintained by periodic calibration of the test equipment against accepted national standards.

23. Keywords

23.1 building evacuation; controlled descent device; emergency evacuation; external evacuation; high-rise; high-rise fires; rescue

APPENDIXES

(Nonmandatory Information)

X1. RATIONALE STATEMENT

X1.1 High-rise buildings are an ever-growing phenomenon in the skylines of cities, worldwide. Constructing new buildings in a way that makes them absolutely safe in event of major fires, explosions, terror attacks, earth quakes or other natural and human-created disasters is extremely difficult, if not impossible, or infeasible. Further, potentially improved design and construction of future buildings will obviously not affect the shortfalls of the tens of thousands of existing buildings, with their millions of exposed tenants. Various events, including the World Trade Center disaster, high-rise fires, and acts of terrorism bring into focus the particular vulnerability of high-rise buildings. Occupants, owners, and employers of occupants of those buildings are now seeking redundancy in ways to evacuate.

X1.2 Issues and problems brought to attention in recent years, with respect to egress include the:

X1.2.1 Capacity of stairs for occupants;

X1.2.2 Capacity of stairs for emergency responder access during an occupant evacuation;

X1.2.3 Inherent limitations of evacuating persons with mobility impairments; and

X1.2.4 The lack of redundancy when the access to stairs and elevators is compromised.

X1.3 To remedy these problems and issues, modifications of stairwell design for new buildings have been recommended by the WTCBCTF (World Trade Center Building Code Task Force), and are under consideration by NFPA (the National Fire Protection Association); however, this will not affect existing buildings.

X1.4 The issue of evacuation from high floors for people with physical limitations may not be improved by these proposed modifications.

X1.5 This standard provides the specification, which governs the design, materials, physical properties, operation and testing requirements of CDD systems. Further, this standard defines requirements for the installation, instruction of those intending to use the CDDs and periodic maintenance of installed CDD systems.

X1.6 Controlled descent devices, CDDs are designed for emergency external evacuation only and are intended for use as a last resort during emergency situations. Nothing in this standard changes the currently required means of egress. Rather, the intent is to provide building owners/occupants with an alternate evacuation route that is only to be used if the primary and secondary egress routes are unavailable, overwhelmed or obstructed in any way.

X1.7 This standard recognizes that CDD systems could be used under hazardous conditions and therefore requires manufacturers to analyze these hazards in conjunction with the use of their CDD systems.

X1.8 CDD systems may be purchased by individual high-rise apartment and condo dwellers, for their families, business tenants, for their employees, building owners or others requiring a last resort means of evacuation.

X2. THE USE OF THE TEST METHODS FROM EXISTING STANDARDS

X2.1 *Test Methods for Testing CDD*—This appendix identifies the test methods that are used to accomplish the required testing of CDDs, identifies the test methods contained in existing standards and defines how those existing test methods shall be used in this standard.

X2.2 *Static Resistance Test*—This test verifies that CDDs can withstand the required static resistance using the test methods, equipment and set up of CSA Z259.2.3-99, 6.4.2.1. The force is to be applied will be the specified static loads of Section 9, to satisfy the requirements of this standard.

X2.2.1 Test methods, test equipment and setup as defined in CSA Z259.2.3-99, 6.4.2.1 are used to conduct the tests. The test equipment and the specific set up may be modified by the

testing authority as necessary to accommodate the specific requirements of different CDD system designs.

X2.2.2 CDDs will be tested to verify the specified rate of descent, using section 16.4 of this standard, after completion of the static resistance test.

X2.3 *Dynamic Strength Test*—The test methods of CSA 259.2.3-99, 6.3.1 providers test methods for verification of CDD dynamic strength and shall be used to test the dynamic strength of CDD systems that do not employ force limiters. The test methods of ANSI Z359.1-1992, 4.3.7.1 provides test methods that are consistent with the performance of CDD systems that use force limiters and shall be used to test CDD systems defined by this standard that use force limiters. The specific parameters to be measured shall verify the requirements of the CDD standard as required by section 16.2.

X2.3.1 The CSA and ANSI standards define test methods, equipment, test set up and the specific construction of test weights. Minor changes to the test equipment defined in CSA 259.2.3-99 and ANSI Z359.1 is required to accommodate testing of CDD systems that use rails or tracks. These modifications shall be accomplished by the test authority. Testing to verify conformance to the rate of descent requirements of this CDD standard shall be conducted, in accordance with section 16.4, after completion of the dynamic strength testing.

X2.4 *Descent Energy, Temperature Rise, and Endurance Test*—Descent energy and endurance testing is conducted using the test methods of prEN 341 (E), 5.7. The test methodology, jigs and fixtures are defined by prEN 341 (E) 5.7 which provides the test methods to be used for accomplishing the tests required by section 16.3. The specific parameters to be verified are those of this CDD standard, including the weights of test loads, number of descents required and testing to the specific descent energy requirements of section 8.7 of this standard.

X2.5 *Rate of Descent Test*—The test methods, equipment and set up of prEN 341:2002 (E) 4.82 and 4.8.3, provide the test methods, test equipment design and set up which is used in testing to the requirements of section 16.4 Rate of Descent Test. The specific parameters of load weight, height and number of repeated operations to be tested will be those required by this standard. The test equipment defined by prEN 341:2002 (E) may be modified, by the test authority, to accomplish the test requirements of this standard.

X2.6 *Resistance to Slippage*—The test methods, test equipment and set up of CSA Z259.2.3-99, Section 6.4.2.1 is used to perform this test. The set-up will be adapted to allow the slippage test to be performed, the test loads and test duration shall be shall be as specified in Section 10 in order to verify the specified requirements of this CDD standard.

X2.7 *Wet Test*—Wet conditioning is conducted, using the methods of CSA Z259.2.3-99, 5.3 on all CDD system components that are designed to be installed or stored on the outside of buildings and the test methods of UL 1523, page 9 shall be used for CDD systems components that are designed to be stored or installed inside of buildings. Both UL 1523 and CSA Z259.2.3-99 provide specific wet conditioning methods and procedures are used without modification.

X2.8 *Extreme Temperature Test*—CDD systems are conditioned in accordance with the requirements of CSA Z259.2.3-99, Sections 5.2 and 5.4, as required by section 14.4 of this specification and tested as required by CSA Z259.2.3-99, Section 6.4.8, in accordance with section 16.4 of this specification within 5 min after completion of the cold conditioning. The conditioning temperatures are in accordance with the requirements of this standard.

X2.9 *Wet and Cold Test*—CDD systems are conditioned in accordance with the requirements of CSA Z259.2.3-99, Section 5.2 as required by section 14.5 of this specification and tested as required by CSA Z259.2.3-99, Section 6.4.9, in accordance with section 16.4 of this specification within 5 min of completing the required conditioning. The conditioning temperatures shall be in accordance with the requirements of this standard.

X2.10 *Flame Exposure Test*—The testing in accordance with the requirements of sections 16.9.1, 16.9.2 and 16.9.3 will be conducted using the test methods of UL 1523, Section 16. The exposure temperatures and times to be tested are those required by this standard, sections 8.3-8.3.3. The distance from the heat source defined in UL 1523 shall be calculated, measured or otherwise determined by the test authority.

X2.11 *Overload Test*—The overload test requirements of sections 16.10.1, 16.10.2 and 16.10.3 are accomplished using the test methods of UL 1523, 17.5. The weight of the test loads shall be those required by section 9.11 of this standard.

X2.12 *Rescue Line Termination Test*—The rescue line end termination test is accomplished using the test methods of prEN 341:(E), Section 5.4. The load values used during the testing shall be those required by Section 16.11.

X2.13 *Rescue Line Entanglement and Spooling Test*—The rescue line entanglement test methods are those of CSA Z259.2.3-99, Sections 6.4.4 and 6.4.12.

X2.14 *Rescue Line Residual Static Strength*—Rescue line residual static strength is tested using the test methods of CSA Z259.2.3-99, Sections 6.4.4.2 and 6.4.4.3 in accordance with the specific requirements of sections 16.13-16.13.2 of this specification.