

AMERICAN NATIONAL STANDARD

ANSI/ASSE Z359.7-2011 Qualification and Verification Testing of Fall Protection Products

Part of the Fall Protection Code

VERSION **3**



AMERICAN SOCIETY OF
SAFETY ENGINEERS



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American National Standard

**Qualification and Verification Testing of
Fall Protection Products**

Secretariat

American Society of Safety Engineers

1800 East Oakton Street
Des Plaines, Illinois 60018-2187

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Foreword (This Foreword is not a part of American National Standard Z359.7-2011.)

This standard, national in scope, was developed by an Accredited Standards Committee functioning under the procedures of the American National Standards Institute, with the American Society of Safety Engineers (ASSE) as secretariat. This standard establishes minimum requirements for certification of fall protection products covered by the ANSI Z359-series standards.

It is intended that this standard addresses certification for fall protection products covered by the ANSI Z359-series standards will comply with the requirements detailed in this standard.

Neither the standards committee, nor the secretariat, states that this standard is perfect or in its ultimate form. It is recognized that new developments are to be expected, and that revisions of the standard will be necessary as the state-of-the-art progresses and further experience is gained. It is felt, however, that uniform guidelines for fall protection programs are very much needed and that the standard in its present form provides for the minimum criteria necessary to develop and implement a comprehensive managed fall protection program.

The Z359 Committee solicits public input that may suggest the need for revisions to this standard. Such input should be sent to the Secretariat, ASC Z359, American Society of Safety Engineers, 1800 E. Oakton Street, Des Plaines, IL 60018-2187.

This standard was developed and approved for submittal to ANSI by the American National Standards Committee on Standards for Fall Protection, Z359. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, the Z359 Committee had the following members:

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STANDARD REQUIREMENTS**1. SCOPE, PURPOSE, APPLICATIONS, EXCEPTIONS AND INTERPRETATIONS**

1.1 Scope. This standard specifies requirements for qualification and verification testing of ANSI/ASSE Z359, *Fall Protection Code*, products. It includes requirements for third-party testing, witness testing and manufacturer testing of fall protection products to the requirements of the ANSI/ASSE Z359 standards.

1.2 Purpose and Application.

1.2.1 This standard specifies minimum requirements for third-party testing laboratories and product manufacturer testing laboratories when testing fall protection products against the ANSI/ASSE Z359 standards.

1.2.2 This standard specifies minimum requirements for test equipment and the number of test specimens to be used when testing fall protection products against the ANSI/ASSE Z359 standards.

1.2.3 Before any product shall bear an ANSI/ASSE Z359 marking or be represented in any way as being in compliance with any ANSI/ASSE Z359 standard, the requirements of this standard as well as the associated product standard shall be met.

1.3 Exceptions.**EXPLANATORY INFORMATION**

(Not part of American National Standard Z359.7)

E1.1 *It is expected that manufacturers of fall protection products will become compliant with testing practices detailed in this standard within 12 months of the effective date of this standard.*

E1.3 *The current list of respective product standards, at the time of publication, is as follows:*

ANSI/ASSE Z359.0, Definitions and Nomenclature Used for Fall Protection and Fall Arrest

ANSI/ASSE Z359.1, Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components

ANSI/ASSE Z359.2, Minimum Requirements for a Comprehensive Managed Fall Protection Program

ANSI/ASSE Z359.3, Safety Requirements for Positioning and Travel Restraint Systems

ANSI/ASSE Z359.4, Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Subsystems and Components

ANSI/ASSE Z359.6, Specifications and Design Requirements for Active Fall Protection Systems

ANSI/ASSE Z359.12, Connecting Components for Personal Fall Arrest Systems

ANSI/ASSE Z359.13, Personal Energy Absorbers and Energy Absorbing Lanyards

1.3.1 Performance and design requirements for individual products are specified in the respective product standard from the ANSI/ASSE Z359, *Fall Protection Code*, standards.

1.4 Interpretations. Requests for interpretations of this standard shall be in writing and addressed to the Secretariat of this standard.

2. DEFINITIONS

Refer to ANSI/ASSE Z359.0, *Definitions and Nomenclature Used for Fall Protection and Fall Arrest*, for definitions of terms used in this standard.

3. GENERAL

3.1 Qualification and verification testing of fall protection products shall be performed in accordance with the requirements of this standard and the relevant ANSI/ASSE Z359 standard.

3.2 Qualification and verification testing of fall protection products shall be performed only by a laboratory which satisfies the requirements of this standard.

3.3 ISO standards referenced reflect the most current editions of ISO 17011, *General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies*, and ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*.

3.4 Manufacturers shall not claim compliance to portions or segments of the requirements of the re-

E2 ANSI/ASSE Z359.0 defines a Product as “A component, subsystem or system inclusive of all packaging, markings and instructions at the point of sale by the manufacturer.”

E3.2 The testing laboratory can consist of either a third-party testing laboratory or a manufacturer’s in-house testing laboratory compliant with this standard.



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spective ANSI/ASSE Z359 standard. Products shall meet the requirements of the complete ANSI/ASSE Z359 standard, and shall be tested to be compliant by a testing laboratory that meets the requirements of this standard.

3.5 All products labeled as being compliant with the respective ANSI/ASSE Z359 standard shall meet or exceed all applicable requirements specified in the respective ANSI/ASSE Z359 standard.

3.6 Testing laboratories performing compliance testing on fall protection products shall be accredited by an outside accreditation body accredited to ISO 17011, *General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies*, to ensure conformity with test and documentation requirements set forth in this standard.

3.7 Testing laboratories shall only test fall protection products to the most up to date or current edition of the applicable ANSI/ASSE Z359 product standard being tested to.

3.8 Any variance that affects the compliant product's performance, design and/or function with regard to the respective ANSI/ASSE Z359 standard shall constitute a different product model.

***E3.7** Testing is intended to be in accordance with the ANSI/ASSE Z359.1 standard or the latest Z359 product standard whichever is the most recent version.*

***E3.8** Product models where the manufacturer can prove that a variance from design or appearance does not change the function or performance of the product, may use the same test specimens and results to illustrate conformity with this and the applicable product standard. An example of a model variance that would not require repeat testing would include a full body harness that has size options of small, medium and large. An example of a model variance that would require the model to be individually tested would be a self-retracting lifeline (SRL) that is available in different lengths. Each model length would be tested to the specific product standard.*

4. TESTING

4.1 Test Equipment.

4.1.1 Drop Test Structure. The drop test structure shall have sufficient height and lateral clearance within the drop zone beneath the test anchorage or anchorage connector on the structure to perform the drop tests required by the appropriate Z359 standard without members of the structure

***E4.1.1** The elastic deformation of the test anchorage and test anchorage connector may be determined by means of theoretical calculations performed by a qualified person.*

or its base interfering with or obstructing the drops before termination of the tests. The required minimum natural frequency of the drop test structure shall be 200 Hz when measured along the vertical axis through the point on the test anchorage or anchorage connector to which the test specimen is attached. The maximum elastic deformation of the test anchorage and test anchorage connector at the point of attachment of the test specimen shall be 0.04 inches (1mm) when subjected to a vertical static load of 4,500 lbs (20kN).

4.1.2 Test Weight. Refer to the respective ANSI/ASSE Z359 standard being tested to for information on test weight specifications including size, mass, center of gravity, etc. specific to the standard.

4.1.3 Test Torso. Refer to the respective ANSI/ASSE Z359 standard being tested to for information on test torso specifications including size, mass, center of gravity, etc. specific to the standard.

4.1.4 Test Lanyard. Refer to the respective ANSI/ASSE Z359 standard for requirements for the test lanyard to be used in performing any tests. At a minimum it shall be fabricated from Type 302 stainless steel, 7x19 aircraft cable construction in accordance with MIL-W-83420E, *Military Specification: General Specifications for Wire Rope, Flexible, for Aircraft Control*. It shall have a diameter of 3/8 inch (10mm) and shall have a length as required by the test to be conducted in the respective ANSI/ASSE Z359 standard, equipped with eye splices at each end and measured from bearing point to bearing point between connectors when the lanyard is under a tension of 10 lbs (4.5kg) +/- 0.1 lbs (.05kg). To prevent slippage, the lanyard eyes shall be formed by Flemish eye splices and secured with swaged fittings.

4.1.5 Test Instrumentation. The dynamic test instrumentation shall consist of a load cell (transducer) and other amplification, filtration and recording equipment as necessary to meet the additional requirements of this section. The load cell shall be attached securely to the anchorage or anchorage connector on the test structure. It shall be capable of registering momentary peak loads up to 5,000 lbs (22kN) and be accurate within 0.5% of its range.

E4.1.2 Depending on the specific test(s) being performed, there may be a requirement for different test weight masses.

E4.1.3 Depending on the specific test(s) being performed there may be a requirement for different test weight masses.

E4.1.4 The connector used for the test lanyard should be appropriate size, shape and strength for the test being conducted. Shackles with a 5:1 safety factor are commonly used.



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The recording data channel shall have a minimum sampling rate of 1,000 samples per second and an active frequency response band up to a corner frequency of 100 Hz plus 1/2 dB minus 3 dB.

4.1.6 Corner Frequency. The maximum arrest-force measurement system shall have a corner frequency of 100 Hz with frequency response characteristics that fall within the shaded area illustrated in Figure 1.

4.1.7 Quick Release Mechanism. The test weight or test torso shall be released by a remotely operated quick release mechanism which shall release the test weight without imparting any motion to it. The quick release mechanism shall synchronously trigger recording through the data channel upon release of the test weight. An alternative method of triggering the data channel may be used provided the data channel trigger's coordination with the quick release mechanism allows capture of the entire fall arrest time history.

4.1.8 Tension Test Gage. The tension test gage shall be capable of measuring static tensile forces in the range from 1/2 pound (2.2N) to 60 pounds (267N) with an accuracy +/- one percent.

4.1.9 Requirements of Specific Standard. Refer to the respective ANSI/ASSE Z359 standard being tested to for any additional test equipment requirement specific to that standard.

4.2 Test Specimens. Test specimens for qualification and verification testing shall be new and in unused condition and be a regular production unit identical to a unit from a regular production lot of a given product model. They shall conform in all respects to the manufacturer's specifications for the model to be tested.

4.2.1 When performing qualification testing on a new product, a minimum of three test specimens will be tested. The test specimens shall be configured as defined by the applicable test method.

4.2.2 When performing verification testing on an existing product, a minimum of one sample of each compliant product shall be inspected, tested and

E4.1.7 The majority of testing facilities use electronic, pneumatic or hydraulic quick releases since manually operated quick releases cannot be operated without imparting motion to the test weight/torso.

E4.2 Qualification testing is considered initial testing on a product, verification testing is considered testing performed on an existing product that has gone through qualification testing in the past. Verification testing is intended to ensure continued product compliance.

evaluated to the design requirements specified in the respective ANSI/ASSE Z359 standard by the testing laboratory.

5. ACCREDITATION BODY

5.1 The accreditation body shall audit and ensure that the testing laboratory meets the requirements of this standard and ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*.

5.2 The accreditation body shall not have a monetary interest in the profitability of any tested product.

5.3 The accreditation body shall not be owned or controlled by manufacturers or vendors of the product being tested.

5.4 The accreditation of a testing laboratory shall be issued by an accreditation body operating in accordance with ISO 17011, *General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies*.

5.5 The registration of the ISO or equivalent Quality Management Program (QMP) shall be issued by an accreditation body operating in accordance with ISO 17021, *Conformity Assessment Requirements for Bodies Providing Audit and Certification of Management Systems*.

E5.4 The accreditation body operating in accordance with ISO 17011 should be a signatory to the International Laboratory Accreditation Cooperation (ILAC).

E5.5 The accreditation body operating in accordance with ISO 17021 should be a signatory to the International Accreditation Forum (IAF).

6. FALL PROTECTION PRODUCT QUALIFICATION AND/OR VERIFICATION TESTING OPTIONS

6.1 Qualification and verification testing can be performed at a laboratory that is either:

6.1.1 A third-party organization with laboratory facilities accredited to perform product compliance testing to the ANSI/ASSE Z359 standards; or

6.1.2 A manufacturer's laboratory accredited to perform compliance testing to the ANSI/ASSE Z359 standards.

E6 It is the intent of this standard to ensure that results from third-party testing laboratories and manufacturer's testing laboratories in different geographical areas are repeatable and acquired in a consistent manner.



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6.1.2.1 If testing is performed at the manufacturer's ISO 17025 accredited laboratory, the testing shall be witnessed and verified by either a third-party test laboratory representative or by a professional engineer as detailed in 6.3 and 6.4.

6.2 The requirements of this standard, the applicable product standard and ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*, shall be adhered to regardless of where the testing takes place and the personnel that verify the testing. Refer to 6.3 and 6.4 for additional requirements for manufacturers performing in-house testing of fall protection products.

6.3 The manufacturer's test laboratory may perform qualification and verification testing of fall protection products using a third-party testing laboratory representative from an accredited laboratory as a witness to the testing.

6.3.1 The third-party laboratory representative shall be knowledgeable and experienced with respect to the tests to be performed; knowledgeable of fall protection in general; the requirements and tests of the standard being tested to; the requirements of the testing instrumentation and test structure; as well as the product being tested.

6.3.2 The third-party test laboratory representative shall possess a copy of each standard to be tested to, a copy of the Z359.7 standard, and document that the representative(s) preparing the test plan and performing the test have read and understand the applicable standards.

6.3.3 The third-party test representative shall be present to witness the testing at the manufacturer's ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*, accredited test laboratory.

6.3.4 The third-party testing entity and representative shall meet all the requirements of this standard.

6.3.5 The third-party testing entity and representative shall ensure that all applicable ANSI/ASSE

Z359 test criteria are met, the manufacturer's testing documentation is correct and that the testing facility is ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*, accredited.

6.3.6 The third-party testing representative will document in writing that testing was performed according to the applicable ANSI/ASSE Z359 standard being tested to and the results of the testing.

6.3.7 A test report conforming to Section 8.3 will be provided to the manufacturer upon completion of the testing or the third-party testing representative will validate the manufacturer's laboratory test report and findings.

6.4 The manufacturer's test laboratory may perform testing using a professional engineer that is a qualified person with respect to fall protection.

E6.4 *There are three ways that fall protection products can be tested to meet the requirements of this standard:*

1) *The product can be tested at an independent accredited laboratory (third-party testing).*

2) *The product can be tested at the manufacturer's accredited laboratory and that testing may be witnessed by a representative of an accredited independent testing laboratory.*

3) *The product can be tested at the manufacturer's accredited laboratory and be signed off and stamped by a professional engineer and qualified person in fall protection.*

In all cases, the laboratory should be an accredited ISO 17025, General Requirements for the Competence of Testing and Calibration Laboratories.

In all cases, the persons performing the tests should be knowledgeable of the testing requirements for the specific product and general fall protection.

The engineer performing the witness testing duty detailed in 6.4 has an ethical responsibility to be knowledgeable and experienced in fall protection engineering, equipment and methodology. At a minimum they should be considered a qualified person with respect to the ANSI/ASSE Z359.0 definition and have previous experience testing fall protection products.



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6.4.1 The professional engineer/qualified person shall witness the testing at the manufacturer's ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*, compliant test laboratory.

6.4.2 The professional engineer/qualified person shall meet the same requirements set forth in 6.3.1, 6.3.2, 6.3.3 and 6.3.5 of this standard for a third-party laboratory representative and ensure that all applicable ANSI/ASSE Z359 test criteria are met, the manufacturer's testing documentation is correct and that the testing facility is accredited to ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*.

6.4.3 The professional engineer/qualified person shall document in writing that testing was performed according to the applicable ANSI/ASSE Z359 standard being tested to and the results of the testing.

6.4.4 The professional engineer/qualified person shall affix their professional engineer's stamp to a test report conforming to Section 8.3.

7. TESTING LABORATORIES

7.1 Testing laboratories shall meet the requirements of this standard.

7.2 The testing laboratory personnel shall be knowledgeable regarding the fall protection products to be tested and the standard to which the product is to conform to.

7.3 A copy of this standard as well as a copy of each standard to be tested to shall be maintained by the test laboratory.

7.4 The test laboratory shall document that the test laboratory personnel preparing the test plan and performing the test have read the applicable standards.

7.5 The testing laboratory shall be accredited in accordance with ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*.

7.6 The testing laboratory test equipment shall conform to Section 4 of this standard.

7.7 The testing laboratory shall conform to specific testing requirements including specialized structures or test equipment that may be detailed in the product applicable product standard.

7.8 The testing laboratory's scope of accreditation to ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*, shall encompass testing of the specific fall protection products being tested.

7.9 Test results from component manufacturer's testing laboratories can be utilized to indicate conformity of individual components of fall arrest products providing the component manufacturer's testing laboratory conforms to ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*, and they are accredited by an accrediting body that conforms to ISO 17011, *General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies*. The manufacturer shall follow either Section 6.3 or 6.4 to perform conformity testing at the manufacturer's testing laboratory.

***E7.9** Fall protection products do not require repeat testing if proof of testing to the applicable ANSI/ASSE Z359 standard from an ISO 17025 accredited test laboratory can be provided. For example, a carabiner that has been tested and proven to meet ANSI/ASSE Z359.12 by the carabiner manufacturer, who has an ISO 17025 accredited laboratory, does not need to be tested again for use in conjunction with another ANSI/ASSE Z359 compliant product.*

8. DUTIES AND RESPONSIBILITIES OF TESTING LABORATORIES

8.1 The testing laboratory shall not allow the substitution, repair or modification of any product or any product component during testing.

8.2 The testing laboratory shall ensure that only new and unused test specimens are tested.

8.3 A test report shall be produced for each model of product upon which qualification or verification testing is performed. The test report shall contain the following information as a minimum:

- a title;
- testing date;
- product model being tested;
- ISO accreditation of laboratory and accrediting agency;
- name and address of where the testing was performed;

***E8.3** The results of the test should include information on whether or not the product passed or failed the test, and any observations that affected the results of the test should be noted.*



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- the type of testing entity: refer to Section 6 and 10;
- manufacturer's name and address;
- testing method or applicable standards and clauses tested to;
- sample number;
- name, functions and signatures of authorized testing personnel, witness or professional engineer/qualified person;
- results of the testing;
- comments on testing results;
- testing conditions such as ambient temperature, etc. that may be of importance;
- testing configuration information such as test weight and free fall distances that may be of importance;
- any additional required information that is dictated in ISO 17025, General Requirements for the Competence of Testing and Calibration Laboratories.

8.4 The testing laboratory shall ensure that all measuring instrumentation is calibrated according to ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*.

8.5 Testing laboratories shall not test fall protection products that are not within their scope of accreditation.

9. DUTIES AND RESPONSIBILITIES OF THE MANUFACTURER

9.1 Modifications to a product that will affect the test results, strength or performance of the product shall require manufacturer to perform additional testing. Additional testing will be performed as required to the applicable ANSI/ASSE Z359 standard in its entirety.

9.2 The manufacturer shall provide complete units that are identical in form to the end user product to the testing laboratory.

9.3 The manufacturer shall maintain all design documentation, performance evaluation documentation and testing documentation as long as the product model tested is in production and for a minimum of ten years from the date it is removed from production.

9.4 The manufacturer shall establish and maintain a Quality Control Management Program which encompasses the product being tested.

***E9.4** The manufacturer should have a documented Quality Control Management Program in place to ensure that product quality is maintained over time. The depth of the program is the responsibility of the manufacturer. ISO 9001 is an example of such a Quality Control Management Program.*

9.5 The manufacturer shall establish and maintain a Safety Alert and Product Recall System as part of its Quality Control Management Program.

9.6 A test report shall be produced by the manufacturer for each model of product upon which qualification or verification testing is performed if testing is performed at the manufacturer's test laboratory. The test report shall contain the information detailed in Section 8.3 as a minimum.

9.7 Upon request, the manufacturer shall provide the test report defined in Section 8.3 and any applicable product information.

9.8 The manufacturer shall ensure that verification testing is in accordance with Section 10.

9.9 The manufacturer shall ensure the product has been tested to all required sections of the standard to which specific product applies. Partial testing to any ANSI/ASSE Z359 standard is not permitted

10. VERIFICATION TESTING

10.1 All products that are labeled as being compliant with any ANSI/ASSE Z359 standard shall undergo verification testing at an interval not to exceed two years unless the manufacturer has a robust, documented, auditable and registered Quality Management Program (QMP) in accordance with ISO 9001 or its equivalent. If the manufacturer has an ISO 9001 or equivalent QMP, then the verification testing interval shall not exceed five years. The ISO 9001 or equivalent QMP scope must include the individual ANSI/ASSE Z359 standard for the products being tested as well as this standard.

10.1.1 The verification testing can be accomplished by performing lot testing, batch testing or as part of quality control testing that may occur prior to two years or on a more frequent basis providing the



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testing performed tests the product to its respective ANSI/ASSE Z359 standard in its entirety. Testing shall be performed by a laboratory that is ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*, compliant.

10.1.2 Verification testing shall include evaluation to the design requirements and testing to the performance requirements as required by the respective ANSI/ASSE Z359 standard on all manufacturers' compliant product model families.

10.1.3 Any change made to a product that affects the compliant product's performance, design and/or function with regard to the respective ANSI/ASSE Z359 standard shall constitute a different product model.

10.2 The testing laboratory shall acquire a sufficient quantity of samples and components to conduct the applicable tests as required by the respective ANSI/ASSE Z359 standard.

10.3 Products shall be inspected, evaluated and tested as specified in the respective ANSI/ASSE Z359 standard.

10.4 Verification testing can be performed by:

10.4.1 A third-party testing laboratory;

10.4.2 Witness testing at the manufacturer's laboratory by a qualified third-party testing laboratory representative; or

10.4.3 By a professional engineer/qualified person taking professional responsibility for the testing performed at a manufacturer's testing laboratory.

10.4.4 The testing laboratory shall be accredited to ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*, for the tests that are being performed. Refer to Section 6 for more information on options for performing testing.

11. MARKING

11.1 All products that are tested to a specific ANSI/

ASSE Z359 standard shall be marked in accordance with the marking requirements of the individual product's standard.

12. REFERENCES

ANSI/ASSE Z359.0, *Definitions and Nomenclature Used for Fall Protection and Fall Arrest*

ANSI/ASSE Z359.1, *Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components*

ANSI/ASSE Z359.2, *Minimum Requirements for a Comprehensive Managed Fall Protection Program*

ANSI/ASSE Z359.3, *Safety Requirements for Positioning and Travel Restraint Systems*

ANSI/ASSE Z359.4, *Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Subsystems and Components*

ANSI/ASSE Z359.6, *Specifications and Design Requirements for Active Fall Protection Systems*

ANSI/ASSE Z359.12, *Connecting Components for Personal Fall Arrest Systems*

ANSI/ASSE Z359.13, *Personal Energy Absorbers and Energy Absorbing Lanyards*

ISO 9001, *Quality Management Systems Requirements*

ISO 17011, *General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies*

ISO 17021, *Conformity Assessment Requirements for Bodies Providing Audit and Certification of Management Systems*

ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*

MIL-W-83420E, *Military Specification: General Specifications for Wire Rope, Flexible, for Aircraft Control*



AMERICAN SOCIETY OF
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Legend:

a = +/- 1/4 dB

b = + 1/2 dB, -1 dB

c = + 1/2 dB, -3 dB

d = -9 dB/octave

e = -24 dB/octave

fH = 60 Hz

fL = 0.1 Hz

fN = 100 Hz

g = -30 dB

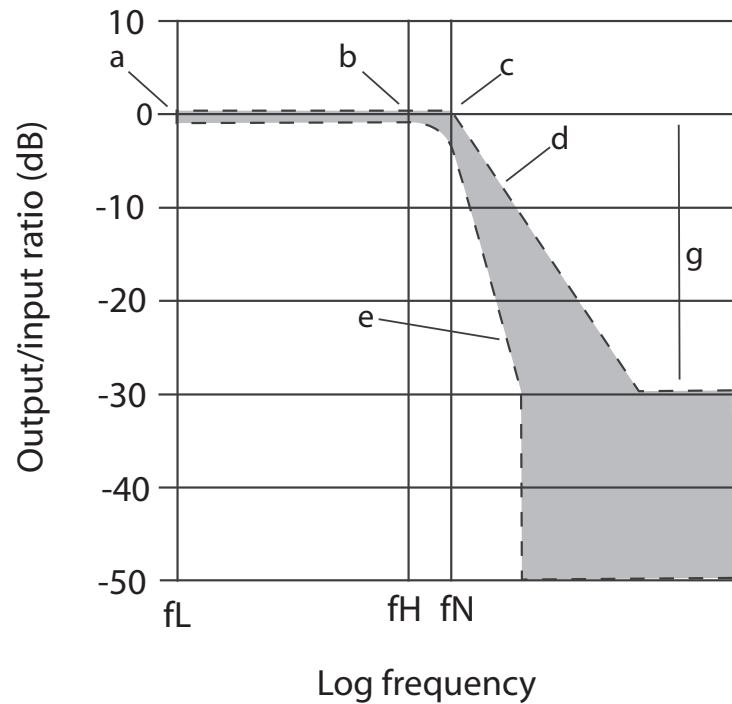


Figure 1: Corner Frequency

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