NFPA®

1936

Standard on Rescue Tools

2020

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NFPA® 1936

Standard on

Rescue Tools

2020 Edition

This edition of NFPA 1936, *Standard on Rescue Tools*, was prepared by the Technical Committee on Fire Department Rescue Tools. It was issued by the Standards Council on June 10, 2019, with an effective date of June 30, 2019, and supersedes all previous editions.

This edition of NFPA 1936 was approved as an American National Standard on June 30, 2019.

Origin and Development of NFPA 1936

Work on this document began in a subcommittee of the Technical Committee on Fire Department Equipment. In October 1992, the NFPA Standards Council organized a new committee, the Technical Committee on Fire Department Rescue Tools, which took over the responsibility for developing the document. The first edition of NFPA 1936 was presented to the NFPA membership at the Annual Meeting in Baltimore, MD, on May 19, 1999, and issued by the Standards Council on July 22, 1999, with an effective date of August 13, 1999.

The second edition of NFPA 1936 incorporated the *Manual of Style for NFPA Technical Committee Documents* format for codes and standards, which caused the renumbering of some chapters, the relocation of another chapter, and the addition of a new chapter. The title of the document was changed to "Powered Rescue Tools," eliminating the "system" concept of the first edition. The standard addressed the tools and components as individual items and not as a "system" approach. All design, performance, and testing requirements were reviewed and refined as necessary.

The second edition was presented to the association membership at the 2004 November meeting in Miami Beach, FL, on November 17, 2004, and issued by the Standards Council with an effective date of February 7, 2005.

The 2010 edition updated referenced publications and product label requirements.

The 2015 edition included third-party certification as part of the process for manufacturing compliant tools, especially in Chapter 4, where the change was carried throughout. Further, there was a language shift from training documentation to user information, as well as clarification on the requirements for powering a tool and the cutting test.

The 2020 edition includes a title change and content changes to reflect that NFPA 1936 does not apply only to powered rescue tools. The committee added new requirements for labels to ensure that they are permanent, unalterable, and sized appropriately for the intended rescue tool. Also updated were requirements for rescue tools used for cutting to ensure they can cut the more commonly used high-strength materials noted in new Figure 5.6.15.1 in Chapter 5.

Finally, the committee removed requirements for rescue struts. Existing material related to rescue struts is incomplete and requires more work, and new requirements for struts must be developed.

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This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents related to the design, inspection, testing, and use of rescue tools for the fire services.

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NFPA 1936

Standard on

Rescue Tools

2020 Edition

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced and extracted publications can be found in Chapter 2 and Annex B.

Chapter 1 Administration

1.1 Scope.

Δ **1.1.1** This standard shall specify the minimum requirements for the design, performance, testing, and certification of rescue tools and components thereof.

Δ **1.1.2** This standard shall specify the requirements for spreader, ram, cutter, combination powered rescue tools, and lifting bags.

Δ **1.1.3** This standard shall also specify the requirements for cable assemblies, hose assemblies, power unit components for powered rescue tools, and lifting bags.

Δ **1.1.4** This standard shall not specify any requirements for any accessories for powered rescue tools.

Δ **1.1.5 Safety and Health.**

N **1.1.5.1** This standard shall not be construed as addressing all of the safety concerns, if any, associated with its use.

N **1.1.5.2** It shall be the responsibility of the persons and organizations that use this standard to establish safety and health practices and determine the applicability of regulatory limitations prior to use of this standard.

1.1.6 Nothing herein shall restrict any jurisdiction from specifying powered rescue tools or lifting bags and components thereof that exceed the minimum requirements of this standard.

1.1.7 Nothing herein shall restrict any manufacturer from producing powered rescue tools, lifting bags, and components thereof that exceed the minimum requirements of this standard.

1.2 Purpose.

1.2.1 The purpose of this standard shall be to establish minimum performance requirements for powered rescue tools, lifting bags, and components thereof that are used by emergency services personnel to extricate victims from entrapment.

1.2.2 Controlled laboratory, environmental, and physical tests are used to determine compliance with the performance requirements of this standard only; however, such tests shall not be deemed as establishing the performance levels of powered rescue tools, lifting bags, and components thereof for all situations.

1.2.3 This standard is not intended to serve as a detailed manufacturing or purchase specification but shall be permitted to be referenced in purchase specifications as minimum acceptable requirements.

1.3 Application.

1.3.1 This standard shall apply to the design, manufacturing, and certification of manufactured powered rescue tools, lifting bags, and components thereof.

1.3.2 The requirements of this standard shall not apply to accessories that might be attached to powered rescue tools, lifting bags, or components thereof.

1.3.3 This standard shall not apply to manually powered rescue tools and manually powered rescue tool components.

Δ **1.3.4** This standard shall not apply to small multipurpose tools including, but not limited to, saws, drills, chisels, pry bars, and similar tools.

1.3.5 This standard shall not apply to powered rescue tools and components thereof that are manufactured prior to the NFPA effective date of this standard.

1.3.6 This standard shall not apply to powered rescue tools that are manufactured in accordance with other specifications or standards of other organizations.

1.4 Units.

1.4.1 Values for measurement in this standard are followed by an equivalent in parentheses, but only the first stated value shall be regarded as the requirement.

1.4.2 Equivalent values in parentheses shall not be considered as the requirement as these values are approximate.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 30, *Flammable and Combustible Liquids Code,* 2018 edition.

NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting,* 2018 edition.

2.3 Other Publications.

2.3.1 ANSI Publications. American National Standards Institute, Inc., 25 West 43rd Street, 4th floor, New York, NY 10036.

ANSI S12.36, *Standard Survey Methods for the Determination of Sound Pressure Levels of Noise Sources*, 1990, revised 1997.

N **2.3.2 ASME Publications.** American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990.

ASME B40.100, *Pressure Gauges and Gauge Attachments*, 2013.

N **2.3.3 ASTM Publications.** ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959.

ASTM A519/A519M, *Standard Specification for Seamless Carbon and Alloy Steel Mechanical Tubing*, 2017.

N **2.3.4 CENELEC Publications.** European Committee for Electrotechnical Standardization, CEN-CENELEC Management Centre, Avenue Marnix 17, 4th floor, B - 1000 Brussels.

EN 837-1, *Standard Bourdon Tube Pressure Gauges*, 2016.

EN 837-2, *Pressure Gauges — Part 2: Selection and Installation Recommendations for Pressure Gauges*, 1998.

EN 837-3, *Pressure Gauges — Part 3: Diaphragm and Capsule Pressure Gauges — Dimensions, Metrology, Requirements and Testing*, 1998.

2.3.5 ISO Publications. International Organization for Standardization, ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland.

ISO 2503, *Gas welding equipment — Pressure regulators for gas cylinders used in welding, cutting and allied processes up to 300 bar*, 2009.

ISO 9001, *Quality management systems — Requirements*, 2015.

ISO/IEC 17011, *General requirements for accreditation bodies accrediting conformity assessment bodies*, 2004.

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*, 2005.

ISO/IEC 17065, *Conformity assessment — Requirements for bodies certifying products, processes and services*, 2012.

N **2.3.6 SAE Publications.** SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 6371, *Steel, Mechanical Tubing 0.95Cr – 0.20Mo (0.28 – 0.33C) (SAE 4130).*

2.3.7 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 252, *Standard for Safety Compressed Gas Regulators*, 2017.

UL 969, *Standard for Marking and Labeling Systems*, 1995, revised 2014.

UL 60745-1, *Standard for Hand-Held Motor-Operated Electric Tools — Safety — Part 1: General Requirements*, 2013.

2.3.8 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections. (Reserved)

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Should. Indicates a recommendation or that which is advised but not required.

3.2.7 Standard. An NFPA Standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA Manuals of

Style. When used in a generic sense, such as in the phrase "standards development process" or "standards development activities," the term "standards" includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

3.3 General Definitions.

3.3.1 Accessories. Those items that are attached to the powered rescue tool or to a component thereof, but are not necessary for the rescue tool or component to meet the requirements of this standard.

3.3.2 Certification. A system whereby a third-party certification organization determines that a manufacturer has demonstrated the ability to produce a product that complies with the requirements of this standard, authorizes the manufacturer to use a label on listed products that comply with the requirements of this standard, and establishes a follow-up program conducted by the third-party certification organization as a check on the methods the manufacturer uses to determine continued compliance of labeled and listed products with the requirements of this standard.

3.3.3 Compliant. Verified as meeting or exceeding all applicable requirements of this standard.

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3.3.4 Continual. With respect to the testing of a powered rescue tool, a test sequence performed with pauses or interruptions.

3.3.5 Continuous. With respect to the testing of a powered rescue tool, a test sequence performed without any pauses or interruptions for any purpose.

3.3.6 Creep. Unintended movement.

3.3.7 Cycle. See 3.4.6, Operational Cycle.

N **3.3.8 Deadman Control.** A device designed to automatically return the operational controls to the neutral position in the event that the operational control is released.

3.3.9 Follow-Up Program. The sampling, inspections, tests, or other measures conducted by the third-party certification organization on a periodic basis to determine the continued compliance of listed products that are being produced by the manufacturer to the requirements of this standard.

3.3.10 Identical Rescue Tools. Powered rescue tools that are produced to the same engineering and manufacturing specifications.

3.3.11 Manufacturer. The entity that assembles the compliant product and also maintains the certification.

Δ **3.3.12* Product Label.** A label or marking affixed to powered rescue tools and components thereof by the manufacturer containing general information, care, maintenance, or similar data.

3.3.13 Rescue Tool. Another term for powered rescue tool.

3.3.14 Rescue Tool Components. See 3.4.9, Powered Rescue Tool Components.

3.3.15 System Input. The input pressure or electrical power that the powered rescue tool is subjected to at any given moment.

3.3.16 Third-Party Certification Organization. An independent third-party certification organization that determines product compliance with the requirements of this standard with a labeling/listing/follow-up program.

3.3.17 Tool. Another term for powered rescue tool.

3.3.18 Vendor Confirmation. A written statement by the original manufacturer of a component that states the specification or performance range, or both, of the component.

N **3.4 Powered Rescue Tools.**

3.4.1 Cable Assembly. A powered rescue tool component consisting of the power cable with all permanently attached connectors that connect the powered rescue tool to the power unit.

Δ **3.4.2 Combination Tool.** A powered rescue tool capable of, at a minimum, spreading and cutting.

Δ **3.4.3 Cutter.** A powered rescue tool with at least one movable blade used to cut, shear, or sever material.

3.4.4 Dump Valve. A device on a power unit to redirect all of the system flow to the reservoir.

3.4.5 Hose Assembly. A powered rescue tool component consisting of hose with all permanently attached fittings that connect the powered rescue tool to the power unit.

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3.4.6 Operational Cycle. The movement of the powered rescue tool from the fully closed or retracted position to the fully open or extended position and returned to the fully closed or retracted position.

3.4.7 Power Unit. A powered rescue tool component consisting of a prime mover and the principal power output device used to power the rescue tool.

3.4.8 Powered Rescue Tool. A rescue tool that receives power from the power unit component and generates the output forces or energy used to perform one or more of the functions of spreading, lifting, holding, crushing, pulling, or cutting.

Δ **3.4.9* Powered Rescue Tool Components.** Components such as cable assemblies, hose assemblies, power units, hose reels, and remote valve blocks.

3.4.10 Prime Mover. Part of the power unit component and the energy source that drives the principal power output device of the power unit.

Δ **3.4.11 Pulling Force.** The force to pull generated by a powered rescue tool and measured or calculated at the standard production pulling attachment points on the tool.

Δ **3.4.11.1** ***Highest Pulling Force (HPF).*** The pulling force achieved by the powered rescue tool while operating at the rated system input at the position of the arms or piston where the tool generates its greatest amount of force.

Δ **3.4.11.2** ***Lowest Pulling Force (LPF).*** The pulling force achieved by the powered rescue tool while operating at the rated system input at the position of the arms or piston where the tool generates its least amount of force.

3.4.12 Ram. A powered rescue tool that has an extender that generates extending forces or both extending and retracting forces.

3.4.13 Rated System Input. The maximum input pressure/electrical power at which the powered rescue tool is designed to operate.

3.4.14 Spreader. A powered rescue tool that has at least one movable arm that opens to move material.

Δ **3.4.15 Spreading Force.** The force to push or pull generated by a spreader rescue tool and measured or calculated at the very tips of the spreader arms or ram.

Δ **3.4.15.1** ***Highest Spreading Force (HSF).*** The spreading force achieved by the powered rescue tool while operating at the rated system input at the position of the arms or piston where the tool generates its greatest amount of force.

Δ **3.4.15.2** ***Lowest Spreading Force (LSF).*** The spreading force achieved by the powered rescue tool while operating at the rated system input at the position of the arms or piston where the tool generates its least amount of force.

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N **3.5 Lifting Bags.**

N **3.5.1 Allowable Pressure (AP).** The maximum operating pressure for each component of the system stated in bar and psi.

N **3.5.2 Components.** See 3.5.10.2, Lifting Bag Components.

N **3.5.3 Control Device.** A lifting bag system component that controls the inflation and deflation of a lifting bag.

N **3.5.4 Couplings.** Connectors attached to the hose assemblies, lifting bags, or accessories to allow for the connection and disconnection of components.

N **3.5.5 Hose Assembly.** A hose complete with attached quick-action coupler(s) with or without fittings.

N **3.5.6 Identical Lifting Bags.** Lifting bags produced to the same engineering and manufacturing specifications.

N **3.5.7 Inflation Height.** The sum of the insertion height and the inflated proportion of a bag's maximum inflation height.

N **3.5.8 Inlet Connection.** A fitting incorporated into a lifting bag in such a way that it is not readily removable, to which a quick-action coupling is connected.

N **3.5.9 Insertion Height.** The smallest opening into which a deflated bag can be inserted.

N **3.5.10 Lifting Bag System.** The combination of components, excluding the air source, that, when assembled, can inflate or deflate a lifting bag using compressed air from an operator-controlled air source.

N **3.5.10.1** ***Lifting Bag.*** A portable inflatable bag used to apply force to move or lift objects.

N **3.5.10.2** ***Lifting Bag Components.*** Components such as a hose and hose assembly, regulator, pressure indicator, safety valve, and a control device.

N **3.5.11 Lifting Capacity.** The maximum load a lifting bag can lift at allowable pressure.

N **3.5.12 Loss of Integrity.** Damage caused by leakage, delaminating, or unexpected deformation.

N **3.5.13 Maximum Lifting Height.** The sum of the insertion height and stroke of the lifting bag.

N **3.5.14 Operational Cycle.** The movement of the lifting bag from the fully deflated position to the fully inflated position and then returned to the fully deflated position.

N **3.5.15 Preset Regulator.** A regulator set before incorporation into a lifting bag system to a defined pressure level and not intended to be easily adjusted by the user.

N **3.5.16 Pressure Indicator.** A device that measures and visually displays pressure.

N **3.5.17 Quick-Action Couplings.** Couplings designed for quick connection and disconnection.

N **3.5.18 Regulator.** A device for regulating a generally variable inlet pressure to as constant as possible outlet pressure.

N **3.5.19 Stroke.** The distance from the insertion height to the maximum inflated position at allowable pressure without a load applied.

N **3.5.20 System Input.** The input pressure a lifting bag is subjected to at any given moment.

N **3.5.21 Volume.** Geometric internal volume of a lifting bag when inflated to allowable pressure without load.

Chapter 4 Certification

4.1 General.

Δ **4.1.1** The process of product certification being compliant with NFPA 1936 shall meet the requirements of Sections 4.1 through 4.4.

Δ **4.1.2 Compliance.**

N **4.1.2.1** All products that are labeled as being compliant with this standard shall meet or exceed all applicable requirements specified in this standard.

N **4.1.2.2** All products that are labeled as being compliant with this standard shall be certified by a third-party certification organization.

Δ **4.1.3 Certification and Accreditation.**

N **4.1.3.1** All certifications shall be performed by a third-party certification organization that meets at least the requirements specified in Section 4.2, and that is accredited for powered rescue tools or lifting bags, as applicable, in accordance with ISO/IEC 17065, *Conformity assessment — Requirements for bodies certifying products, processes and services.*

N **4.1.3.2** The accreditation shall be issued by an accreditation body operating in accordance with ISO/IEC 17011, *General requirements for accreditation bodies accrediting conformity assessment bodies.*

4.1.4 Manufacturers shall not claim compliance with portions or segments of the requirements of this standard and shall not use the NFPA name or the name or identification of this standard, NFPA 1936, in any statements about their respective product(s) unless the product(s) is certified by a third-party certification organization as compliant to this standard.

4.1.5 All compliant products shall be labeled and listed by a third-party certification organization.

4.1.6 All compliant products shall also have a product label that meets the requirements specified in Sections 5.2 and 6.2.

Δ **4.1.7*** The third-party certification organization's label, symbol, or identifying mark shall be part of the product label, attached to the product label, or immediately adjacent to the product label.

4.1.8 The third-party certification organization shall not issue any new verifications to the 2015 edition of this standard on or after the NFPA effective date for the 2020 edition.

4.1.9 The third-party certification organization shall not permit any manufacturer to continue to label any products that are certified as compliant with the 2015 edition of this standard on or after July 1, 2020.

Δ **4.1.10 Certification Label Removal.**

N **4.1.10.1** The third-party certification organization shall require manufacturers to remove all certification labels and product labels indicating compliance with the 2015 edition of this standard from all powered rescue tools and components that are under the control of the manufacturer on July 1, 2020.

N **4.1.10.2** The third-party certification organization shall verify the action in 4.1.10.1 is taken.

4.2 Certification Program.

4.2.1* The third-party certification organization shall not be owned or controlled by manufacturers or vendors of the product being certified.

4.2.2 The third-party certification organization shall be primarily engaged in certification work and shall not have a monetary interest in the product's ultimate profitability.

4.2.3 The third-party certification organization shall be accredited for powered rescue tools or lifting bags, as applicable, in accordance with ISO/IEC 17065, *Conformity assessment — Requirements for bodies certifying products, processes and services*, with the accreditation issued by an accreditation body operating in accordance with ISO/IEC 17011, *General requirements for accreditation bodies accrediting conformity assessment bodies*.

4.2.4 The third-party certification organization shall refuse to certify products to this standard that do not comply with all applicable requirements of this standard.

4.2.5* The contractual provisions between the third-party certification organization and the manufacturer shall specify that product certification is contingent on compliance with all applicable requirements of this standard.

4.2.5.1 The third-party certification organization shall not offer or confer any conditional, temporary, or partial product conformance verifications.

4.2.5.2 Manufacturers shall not be authorized to use any label of or reference to the third-party certification organization on products that are not compliant with all applicable requirements of this standard.

4.2.6* The third-party certification organization shall have laboratory facilities and equipment available for conducting proper tests to determine product compliance.

4.2.6.1 The third-party certification organization laboratory facilities shall have a program in place and functioning for calibration of all instruments, and procedures shall be in use to ensure proper control of all testing.

4.2.6.2 The third-party certification organization laboratory facilities shall follow good practice regarding the use of laboratory manuals, form data sheets, documented calibration and calibration routines, performance verification, proficiency testing, and staff qualification and training programs.

4.2.7 The third-party certification organization shall require the manufacturer to establish and maintain a quality assurance program that meets the requirements of Section 4.4. The third-party certification organization shall verify the manufacturer's quality assurance program to ensure that the quality assurance program provides continued product compliance with this standard.

4.2.8 The third-party certification organization and the manufacturer shall evaluate any changes affecting the design, construction, or materials of the compliant product to determine its continued conformance to this standard.

4.2.9* The third-party certification organization shall have a follow-up inspection program of the manufacturing facilities of the compliant product with at least two random and unannounced visits per 12-month period.

4.2.9.1 As part of the follow-up inspection program, the third-party certification organization shall select sample compliant product at random from the manufacturer's production line, from the manufacturer's in-house stock, or from the open market.

4.2.9.2 Sample product shall be evaluated by the third-party certification organization to verify the product's continued compliance.

4.2.10 The third-party certification organization shall have in place a series of procedures that address report(s) of situation(s) in which a compliant product is subsequently found to be hazardous.

4.2.11 The third-party certification organization's operating procedures shall provide a mechanism for the manufacturer to appeal decisions. The procedures shall include the presentation of information from both sides of a controversy to a designated appeals panel.

4.2.12 The third-party certification organization shall be in a position to use legal means to protect the integrity of its name and label. The name and label shall be registered and legally defended.

4.3 Inspection and Testing.

4.3.1 For certification of product, the third-party certification organization shall conduct both inspection and testing as specified in Section 4.3.

4.3.2 All inspections, evaluations, conditioning, and testing for product conformance verification shall be conducted by a third-party certification organization's testing laboratory that is accredited in accordance with the requirements of ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*.

4.3.2.1 The third-party certification organization's testing laboratory's scope of accreditation to ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*, shall encompass testing of powered rescue tools or lifting bags, as applicable.

4.3.2.2 The accreditation of a third-party certification organization's testing laboratory shall be issued by an accreditation body operating in accordance with ISO/IEC 17011, *General requirements for accreditation bodies accrediting conformity assessment bodies*.

Δ **4.3.3** Sampling levels for testing and inspection shall be established by the third-party certification organization and the manufacturer to ensure that products certified to this standard are compliant, unless such sampling levels are specified herein.

4.3.4 Inspection by the third-party certification organization shall include a review of all product labels to ensure that all required label attachments, compliance statements, certification statements, and other product information are at least as specified for the products in Sections 5.2 and 6.2.

Δ **4.3.5** Inspection by the third-party certification organization shall include an evaluation of any symbols and pictorial graphic representations used on product labels or in user information, as permitted by 5.2.1.6 and 5.3.3, to ensure that the symbols are explained in the product's user information package.

Δ **4.3.6** Inspection by the third-party certification organization shall include a review of the user information required by Sections 5.3 and 6.3 to ensure that the information has been developed and is available.

Δ **4.3.7** Inspection by the third-party certification organization for determining compliance with the design requirements specified in Sections 5.4 and 6.4 shall be performed on whole or complete products.

Δ **4.3.8** Testing to determine product compliance with the performance requirements specified in Sections 5.5 and 6.5 shall be conducted by the third-party certification organization in accordance with the specified testing requirements of Sections 5.6 and 6.6.

4.3.8.1 Testing shall be performed on whole products.

4.3.8.2 The third-party certification organization shall also be permitted to use specimens representative of materials and components used in the actual construction of the product.

4.3.9 The third-party certification organization shall accept from the manufacturer, for evaluation and testing for certification, only products or product components that are the same in every respect to the actual final product or product component.

4.3.10 The third-party certification organization shall not allow any modifications, pretreatment, conditioning, or other such special processes of the product or any product component prior to the submission of the product or product component for evaluation and testing by the third-party certification organization.

4.3.11 The third-party certification organization shall not allow the substitution, repair, or modification, other than as specifically permitted herein, of any product or any product component during testing.

4.3.12 The third-party certification organization shall not allow test specimens that have been conditioned and tested for one method to be reconditioned and tested for another test method unless specifically permitted in the second test method.

Δ **4.3.13 Product Changes.**

N **4.3.13.1** Any change in the design, construction, or materials of a compliant product shall necessitate new inspection and testing to verify conformance to all applicable requirements of this standard that the third-party certification organization determines can be affected by such change.

N **4.3.13.2** The certification stated in 4.3.13.1 shall be conducted before labeling the modified product as being compliant with this standard.

4.4 Manufacturer's Quality Assurance Program.

4.4.1* The manufacturer shall be registered to ISO 9001, *Quality management systems — Requirements*.

4.4.2 The operation of the quality assurance program shall evaluate and test compliant product production against this standard to ensure production remains in compliance.

Δ Chapter 5 Powered Rescue Tools

N **5.1 Administration.**

N **5.1.1 Scope.**

N **5.1.1.1** This chapter shall specify the minimum requirements for the design, performance, testing, and certification of powered rescue tools and components thereof.

N **5.1.1.2** This chapter shall specify the requirements for spreader, ram, cutter, and combination powered rescue tools.

N **5.1.1.3** This chapter shall also specify the requirements for cable assemblies, hose assemblies, and power unit components for powered rescue tools.

N **5.1.1.4** This chapter shall not specify any requirements for any accessories for powered rescue tools or components thereof.

N **5.1.1.5 Safety and Health.**

N **5.1.1.5.1** This chapter shall not be construed as addressing all of the safety concerns, if any, associated with its use.

N **5.1.1.5.2** It shall be the responsibility of the persons and organizations that use this standard to establish safety and health practices and determine the applicability of regulatory limitations prior to use of this standard.

N **5.1.1.6** Nothing herein shall restrict any jurisdiction from specifying powered rescue tool systems and components thereof that exceed the minimum requirements of this standard.

N **5.1.1.7** Nothing herein shall restrict any manufacturer from producing powered rescue tools and components thereof that exceed the minimum requirements of this standard.

N **5.1.2 Purpose.**

N **5.1.2.1** The purpose of this chapter shall be to establish minimum performance requirements for powered rescue tools and components thereof that are utilized by emergency services personnel to facilitate the extrication of victims from entrapment.

N **5.1.2.2** Controlled laboratory, environmental, and physical tests are used to determine compliance with the performance requirements of this chapter only; however, such tests shall not

be deemed as establishing the performance levels of powered rescue tools and components thereof for all situations.

N **5.1.2.3** This chapter is not intended to serve as a detailed manufacturing or purchase specification but shall be permitted to be referenced in purchase specifications as minimum acceptable requirements.

N **5.1.3 Application.**

N **5.1.3.1** This chapter shall apply to the design, manufacturing, and certification of manufactured powered rescue tools and components thereof.

N **5.1.3.2** The requirements of this chapter shall not apply to accessories that might be attached to powered rescue tools or components thereof.

N **5.1.3.3** This chapter shall not apply to manually powered rescue tools and manually powered rescue tool components.

Δ **5.2 Product Labeling Requirements.**

N **5.2.1 General.**

N **5.2.1.1** All product labels for powered rescue tools and for power unit components shall also meet the requirements specified in 5.2.2.

N **5.2.1.2** All product labels for cable assembly components and hose assembly components shall also meet the requirements specified in 5.2.3.

N **5.2.1.3** On all product labels, the font size for the third-party certification organization's label, symbol, or identifying mark and the compliance statement shall be at least 2 mm (3⁄32 in.) high.

N **5.2.1.4** On all product labels, the font size for the itemized information list that follows the compliance statement, including any symbols, shall be at least 2 mm (3⁄32 in.) high.

N **5.2.1.5** All product labels shall have the text printed at least in English.

N **5.2.1.6** All product labels shall be permitted to use symbols and other pictorial graphic representations to supplement worded statements on the product labels where those symbols and pictorial graphic representations are explained in the user information.

N **5.2.1.7** All product labels shall meet the requirements of UL 969, *Standard for Marking and Labeling Systems*, for resistance to damage from temperatures between −29°C and 71°C (−20°F and 160°F) outdoor use, and exposure to oil, fuel, water, and the hydraulic fluids used in the rescue tools.

N **5.2.1.8** In addition to 5.2.1.7, where any required product labels are self-adhesive, the adhesion shall be applicable for the adhered surface.

N **5.2.1.9** The powered rescue tool manufacturer shall provide the country of manufacture in either the manual or on the product label.

Δ **5.2.2 Powered Rescue Tools and Power Unit.**

N **5.2.2.1** Each powered rescue tool and each power unit shall have a product label permanently attached to the tool or system.

Δ **5.2.2.2** Each product label shall have the third-party certification organization's label, symbol, or identifying mark and at least the following compliance statement printed on the product label:

THIS (insert "POWERED RESCUE TOOL" or "POWER UNIT" as applicable) MEETS THE REQUIREMENTS OF NFPA 1936, *STANDARD ON RESCUE TOOLS*, 2020 EDITION.
DO NOT REMOVE THIS LABEL.

Δ **5.2.2.3** The following information shall also be printed on the product label following the compliance statement specified in 5.2.2.2:

(1) Manufacturer's name, identification, or designation
(2) Product identification number, lot number, or serial number
(3) Month and year of manufacture (not coded)
(4) Model name, number, or design
(5) Rated system pressure, where applicable
(6) Manufacturer's specified hydraulic fluid for power unit, where applicable
(7) Fluid capacity of the hydraulic reservoir of the power unit, where applicable
(8) Operating voltage and current type, where applicable
(9) Operating amperage at no load, where applicable
(10) Operating amperage at maximum load, where applicable

Δ **5.2.2.4** More than one label piece shall be permitted to carry all statements and information required of the product label; however, all label pieces that compose the entire product label shall be located adjacent to each other.

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N **5.2.3 Cable Assembly and Hose Assembly.**

N **5.2.3.1** Each cable assembly and each hose assembly shall have a product label that is permanently stamped, bonded, or embossed on the cable or hose.

N **5.2.3.2** Each product label specified in 5.2.3.1 shall have the third-party certification organization's label, symbol, or identifying mark and at least the following compliance statement printed as the product label:

MEETS NFPA 1936 (2020 ED.).

N **5.2.3.3** In addition, each cable assembly and each hose assembly shall also have a product label attached to it.

N **5.2.3.3.1** This additional product label shall be permitted to be permanently attached to the assembly or configured as a hangtag attached to the assembly.

N **5.2.3.3.2** Where the additional product label is configured as a hangtag as permitted by 5.2.3.3.1, the hangtag shall have the following printed on the label: DO NOT DISPOSE OF THIS HANGTAG.

N **5.2.3.3.3** Where the additional product label is permanently attached, the following shall be printed on the label:

DO NOT REMOVE THIS LABEL.

N **5.2.3.4** The third-party certification organization's label, symbol, or identifying mark and at least the following statement shall be printed on the additional product label:

THIS (insert "CABLE ASSEMBLY" OR "HOSE ASSEMBLY" as applicable) MEETS THE REQUIREMENTS OF NFPA 1936, *STANDARD ON RESCUE TOOLS*, 2020 EDITION. DO NOT

DISPOSE OF THIS LABEL. STORE THIS LABEL WITH PRODUCT AND USER INFORMATION FOR FUTURE REFERENCE.

N **5.2.3.5** The following information shall also be printed on the additional product label following the compliance statement specified in 5.2.3.4:

(1) Manufacturer's name, identification, or designation
(2) Product identification number, lot number, or serial number
(3) Month and year of manufacture (not coded)
(4) Model name, number, or design
(5) Rated system pressure, where applicable
(6) Manufacturer's specified hydraulic fluid for power unit, where applicable
(7) Fluid capacity of the hydraulic reservoir of the power unit, where applicable
(8) Operating voltage and current type, where applicable
(9) Operating amperage at no load, where applicable
(10) Operating amperage at maximum load, where applicable

N **5.2.3.6** More than one label piece shall be permitted to carry all statements and information required of the additional product label; however, all label pieces of the entire additional product label shall be attached to each other.

N **5.3 User Information.**

N **5.3.1** The powered rescue tool manufacturer shall provide user information for users with each rescue tool and component thereof.

N **5.3.2** Such user information shall be permitted to be in the form of printed, audiovisual, or web-based material, or any combination thereof.

N **5.3.3** Symbols and other pictorial graphic representations shall be permitted to be used to supplement worded statements on the product labels where those symbols and pictorial graphic representations are explained in the user information.

N **5.3.4 Manuals.**

N **5.3.4.1** The powered rescue tool manufacturer shall provide a manual(s) with each rescue tool or component thereof.

N **5.3.4.2** The manual(s) shall provide, at a minimum, the following information:

(1) Manufacturer's name and address
(2) Source for service and technical information
(3) How or where parts can be obtained
(4) Setup procedures
(5) Operating instructions
(6) Safety considerations
(7) Limitations of use
(8) Inspection procedures
(9) Recommended maintenance procedures
(10) Troubleshooting guide
(11) Manufacturer's warranty
(12) Special requirements or data required by this standard

N **5.3.5** The powered rescue tool manufacturer shall specify in the manual the length, width, and height dimensions of all powered rescue tools and components thereof to establish the minimum storage dimensions.

N **5.3.6** The data for the opening distance of cutters and the opening and closing travel distance for other rescue tools as established in 5.4.2.3, 5.4.3.1, 5.4.4.3, 5.4.4.5, and 5.4.5.1 shall be provided in the manual.

N **5.3.7 Ratings.**

N **5.3.7.1** The data on the cutting rating of cutters as established in 5.4.4.4 and 5.4.5.3 shall be provided in the manual.

N **5.3.7.2** Where cutters are rated for cutting high-strength materials, the data on the rating of cutters as established in 5.4.5.5.2 shall be provided in the manual.

N **5.3.8** The data on highest spreading force (HSF), lowest spreading force (LSF), highest pulling force (HPF), and lowest pulling force (LPF) ratings of the rescue tools as established in 5.5.1.4, 5.5.1.5, 5.5.2.5, 5.5.2.6, 5.5.3.6, and 5.5.3.7 shall be provided in the manual.

N **5.3.9** The weight of the rescue tool or component thereof in a ready-to-use configuration shall be provided in the manual.

N **5.3.9.1** The weight of the power unit shall include maximum specified quantities of the hydraulic fluid, fuel, engine oil, and battery, if the power unit requires these items for normal operation.

N **5.3.9.2** The weight of tools and cable assemblies or hose assemblies, including hose reels where provided, shall be determined with the rescue tools and cable or hose assembly attached, and hose assembly filled with hydraulic fluid and configured so that they would be operational by attachment to a power source.

N **5.3.10** The manufacturer of the power unit shall provide copies of any owner's manuals that are provided by the manufacturer of the prime mover.

N **5.3.11** A safety data sheet (SDS) shall be provided for each hydraulic fluid that is supplied for use in the rescue tool and components thereof.

N **5.4 Design Requirements.**

N **5.4.1 General.**

N **5.4.1.1** Where hydraulic fluid is used, the manufacturer of seals, valves, and fittings that will come into contact with hydraulic fluid in the rescue tool shall supply the rescue tool manufacturer with written documentation that such seals, valves, and fittings are compatible with the specified hydraulic fluid for the rescue tool and that they will function at a maximum hydraulic fluid temperature of 71°C (160°F).

N **5.4.1.2** Handles and controls shall be located on the rescue tool to allow the rescue tool to be carried and operated by personnel wearing gloves that are certified as compliant with the glove requirements of NFPA 1971.

N **5.4.1.3** All handles and controls shall be located and designed so that when gripped will prevent the user's hand(s) from being caught or crushed by powered moving parts of the tool during the tool's operation.

N **5.4.1.4** Rescue tools shall be equipped with a "deadman control."

N **5.4.1.4.1** When the operating control is in the neutral position, the rescue tool shall not operate by itself.

N **5.4.1.4.2** The operation of the operating control shall be indicated on the tool.

N **5.4.1.5** Where the rescue tool has an extension area of the activating piston rod assembly that is greater than 1.5 times the retract area of the piston rod assembly, the rescue tool shall be equipped with a built-in automatic safety relief device to prevent overpressurization.

N **5.4.1.6** Where hydraulic fluid is used, the hydraulic fluid specified for use with the rescue tool shall not be classified as either a flammable liquid or a combustible fluid unless classified as a Class IIIB combustible liquid in accordance with NFPA 30.

N **5.4.1.7 Rating.**

N **5.4.1.7.1** Where hydraulic fluid is used, all rescue tool hydraulic fittings and quick-connect couplers shall be rated for, at a minimum, the rated system input.

N **5.4.1.7.2** Where hydraulic fluid is used, all rescue tool hydraulic fittings and quick-connect couplers shall have a safety factor of at least 2:1.

N **5.4.1.8* Check Valves for Quick-Connect Couplers.**

N **5.4.1.8.1** Rescue tools shall be equipped with quick-connect couplers.

N **5.4.1.8.2** Where hydraulic fluid is used, each quick-connect coupler shall have a check valve that can withstand the specified rated system input when disconnected.

N **5.4.1.9** All rescue tool quick-connect couplers shall be designed to prevent accidental uncoupling during operation.

N **5.4.1.10** All controls that are required for the safe operation of the rescue tool shall be marked to indicate their function.

N **5.4.1.11** The length, width, and height dimensions of the rescue tool, as supplied by the tool manufacturer, shall be verified by the third-party certification organization.

N **5.4.1.12 Labels.**

N **5.4.1.12.1** All electric components shall be labeled and listed for the intended application.

N **5.4.1.12.2** Where labeled and listed electric components are not available for a specific application, the electric components that are used shall be evaluated for the intended application by the third-party certification organization.

N **5.4.1.13** Where rescue tools utilize electric power, such rescue tools shall comply with the applicable and appropriate electrical safety requirements in Annex K of UL 60745-1, *Standard for Safety for Hand-Held Motor-Operated Electric Tools — Safety — Part 1: General Requirements.*

N **5.4.1.14** All rescue tool electrical connectors shall be rated to handle the electrical current realized when the system is operating at rated system input.

N **5.4.1.15** A switch or other control device shall be acceptable for the application, with voltage and amperage ratings not less than the corresponding values of the load that it controls.

N **5.4.1.16** Electrical parts of the rescue tool shall be so located or enclosed that protection against unintentional contact with noninsulated live parts shall be provided.

N **5.4.1.17** Strain relief shall be provided to prevent a mechanical stress on a flexible cord from being transmitted to terminals, splicing, or internal wiring.

N **5.4.1.18** Wiring shall be protected from sharp edges, burrs, moving parts, and other conditions that might cause abrasion of the insulation of conductors.

N **5.4.1.19** The electric motor of the rescue tool shall drive the maximum intended load of the tool without introducing risk of fire, electric shock, or injury to persons.

N **5.4.1.20** Where an enclosure as part of the rescue tool or rescue tool component is provided for a battery or battery cell, the enclosure shall be vented to permit the circulation of air for dispersion of gases that can be generated under abnormal battery or battery cell or charging conditions.

N **5.4.1.21** Where an enclosure as part of the rescue tool or rescue tool component is provided for a battery or battery cell, the enclosure shall be provided with means of heat transfer, such as ventilation openings or heat sinks, located so as to prevent thermal runaway of the battery or battery cell during normal charging at the maximum allowable ambient temperature as specified by the battery or battery cell manufacturer.

N **5.4.1.22** Where rescue tools use batteries that are the prime energy source for the rescue tool, such rescue tools shall provide an indicator or other means to visually check the battery's state of charge.

N **5.4.1.23** All battery or battery pack exposed live terminals shall provide a means to prevent accidental contact and arcing when not being used.

N **5.4.2 Additional Requirements for Spreader Rescue Tools.**

N **5.4.2.1 Gripping Surface.**

N **5.4.2.1.1** The outside of the spreader arm ends or tips shall be provided with a gripping surface.

N **5.4.2.1.2** The gripping surface shall extend the full width of the ends or tips.

N **5.4.2.1.3** The gripping surface shall be at least 25 mm (1 in.) in length where measured inward from the ends or tips.

N **5.4.2.2** Double-acting spreaders that are designed for pulling as well as pushing shall have pulling attachment points.

N **5.4.2.3** The opening and closing travel distance of the spreader shall be determined at 21°C, ±3°C (70°F, ±5°F).

N **5.4.2.3.1** The spreader shall be opened to the fullest extent using the rated system input and no external load.

N **5.4.2.3.2** The distance between the tips shall be measured.

N **5.4.2.3.3** The spreader shall then be closed to its full closure using the rated system input and no external load.

N **5.4.2.3.4** The distance between the tips shall again be measured.

N **5.4.2.3.5** The difference in measurements shall be the travel distance.

N **5.4.2.3.6** The opening and closing travel distances of the spreader shall be recorded and verified with the data supplied by the manufacturer.

N 5.4.3 Additional Requirements for Ram Rescue Tools.

N 5.4.3.1 The opening and closing travel distance of the ram shall be determined at 21°C, ±3°C (70°F, ±5°F).

N 5.4.3.1.1 The ram shall be opened to the fullest extent using the rated system input and no external load.

N 5.4.3.1.2 The distance from the base to the tip of the ram shall be measured.

N 5.4.3.1.3 The ram shall then be closed to its full closure using the rated system input and no external load.

N 5.4.3.1.4 The distance from the base to the tip of the ram shall again be measured.

N 5.4.3.1.5 The difference in measurements shall be the travel distance.

N 5.4.3.1.6 The fully retracted and the fully extended lengths of the ram shall be recorded and verified with the data supplied by the manufacturer.

N 5.4.3.2 Rams shall be permitted to pull as well as push.

N 5.4.3.3 Where rams are designed to pull as well as push, they shall be provided with a pulling attachment point.

N 5.4.4 Additional Requirements for Combination Rescue Tools.

N 5.4.4.1 Gripping Surface.

N 5.4.4.1.1 The outer edge of the combination tool arm ends or tips shall be provided with a gripping surface.

N 5.4.4.1.2 The gripping surface shall extend the full width of the ends or tips.

N 5.4.4.1.3 The gripping surface shall be at least 25 mm (1 in.) in length where measured inward from the ends or tips.

N 5.4.4.2 All double-acting combination tools that are designed for pulling as well as spreading shall have pulling attachment point(s).

N 5.4.4.3 The opening distance of the cutter of the combination tool shall be determined at 21°C, ±3°C (70°F, ±5°F).

N 5.4.4.3.1 The cutter shall be opened to the fullest extent using the rated system input and no external load.

N 5.4.4.3.2 The opening distance of the cutter shall be measured in a straight line at the tips of the cutter, with the cutter in the fully open position.

N 5.4.4.3.3 The opening distance of the cutter of the combination tool shall be recorded and verified with the data supplied by the manufacturer.

N 5.4.4.4 The cutter of the combination tool shall be rated using an alphanumeric level rating system for the cutter's ability to cut specific material.

N 5.4.4.4.1 The numerical performance levels and the material categories of the rating system shall be as specified in the performance requirements of 5.5.3.4 and 5.6.13.

N 5.4.4.4.2 Rating Expression.

N 5.4.4.4.2.1* The level rating shall be expressed as A#/B#/C#/D#/E#.

N 5.4.4.4.2.2 The letters A, B, C, D, and E shall indicate the material category, and the performance level number for the specific material category and be inserted in place of the # sign.

N 5.4.4.5 The opening and closing travel distance of the spreader of the combination tool shall be determined at 21°C, ±3°C (70°F, ±5°F).

N 5.4.4.5.1 The spreader shall be opened to the fullest extent using the rated system input and no external load.

N 5.4.4.5.2 The opening shall be measured in a straight line on the outside surface of the arms at the farthest projection of the tips.

N 5.4.4.5.3 The spreader shall then be closed to its full closure using the rated system input and no external load.

N 5.4.4.5.4 The distance between the tips shall again be measured.

N 5.4.4.5.5 The difference in measurements shall be the travel distance.

N 5.4.4.5.6 The opening and closing travel distance of the combination tool spreader shall be recorded and verified with the data that are supplied by the manufacturer.

N 5.4.4.6 Combination tool cutters shall be permitted to be rated for cutting high-strength materials.

N 5.4.4.6.1 Where combination tool cutters are being rated for cutting high-strength materials, the numerical performance level and category of the rating system shall be as specified in 5.5.3.12 and 5.6.15.

N 5.4.4.6.2 The level rating shall be expressed as F#.

N 5.4.4.6.3 The letter F shall indicate the material category, and the performance level number for the specific high-strength material category shall be inserted in place of the # sign.

N 5.4.5 Additional Requirements for Cutter Rescue Tools.

N 5.4.5.1 The opening distance of the cutter shall be determined at 21°C, ±3°C (70°F, ±5°F).

N 5.4.5.1.1 The cutter shall be opened to the fullest extent using the rated system input and no external load.

N 5.4.5.1.2 The opening distance of the cutter shall be measured in a straight line at the tips of the cutter, with the cutter in the fully open position.

N 5.4.5.2 The opening distance of the cutter shall be recorded and verified with the data supplied by the manufacturer.

N 5.4.5.3 The cutter shall be rated using an alphanumeric level rating system for the cutter's ability to cut specific material.

N 5.4.5.3.1 The numerical performance levels and the material categories of the rating system shall be as specified in the performance requirements of 5.5.4.2 and 5.6.13.

N 5.4.5.3.2* The level rating shall be expressed as A#/B#/C#/D#/E#.

N 5.4.5.4 The letters A, B, C, D, and E shall indicate the material category, and the performance level number for the specific material category shall be inserted in place of the # sign.

N 5.4.5.5 Cutters shall be permitted to be rated for cutting high-strength materials.

N **5.4.5.5.1** Where cutters are being rated for cutting high-strength materials, the numerical performance level and category of the rating system shall be as specified in 5.5.4.6 and 5.6.15.

N **5.4.5.5.2** The level rating shall be expressed as F#.

N **5.4.5.5.3** The letter F shall indicate the material category, and the performance level number for the specific high-strength material category shall be inserted in place of the # sign.

N **5.4.6 Cable Assembly and Hose Assembly Components.**

N **5.4.6.1** The manufacturer of hose and couplers for hose assembly components that will come into contact with tool or system hydraulic fluid shall supply the rescue tool manufacturer with written documentation that such hose and couplers are compatible with the specified hydraulic fluid and that they will function at a maximum hydraulic fluid temperature of 71°C (160°F).

N **5.4.6.2** Where hydraulic fluid is used, the hydraulic fluid that is specified for use with hose assembly components shall not be classified as either a flammable or combustible liquid unless classified as a Class IIIB combustible liquid in accordance with NFPA 30.

N **5.4.6.3** Hose assemblies shall have a minimum safety factor against burst of 200 percent.

N **5.4.6.4*** All hose hydraulic fittings and quick-connect couplers shall be rated for at least the rated system input and shall have a minimum safety factor of 200 percent.

N **5.4.6.5** All hose quick-connect couplers shall be designed to prevent accidental uncoupling during operation.

N **5.4.6.6** Electrical cables and wires for cable assembly components shall be rated to handle the electrical current realized when the system is operating at rated system input.

N **5.4.6.7** All quick-connect electrical cables for cable assembly components shall be polarized.

N **5.4.6.8** All electrical cables and wires of cable assembly components shall be insulated to prevent short circuits.

N **5.4.7 Power Unit Components.**

N **5.4.7.1** Where hydraulic fluid is used, the manufacturer of seals, valves, and fittings that will come into contact with hydraulic fluid in power unit components shall supply the rescue tool manufacturer with written documentation that such seals, valves, and fittings are compatible with the specified hydraulic fluid for the rescue tool and that they will function at a maximum hydraulic fluid temperature of 71°C (160°F).

N **5.4.7.2** Where hydraulic fluid is used, the hydraulic fluid that is specified for use with power unit components shall not be classified as either a flammable liquid or a combustible liquid unless classified as a Class IIIB combustible liquid in accordance with NFPA 30.

N **5.4.7.3** All power unit hydraulic fittings and quick-connect couplers shall be rated for at least the rated system input and shall have a minimum safety factor of 200 percent.

N **5.4.7.4** All power unit quick-connect couplers shall be designed to prevent accidental uncoupling during operation.

N **5.4.7.5** Handles and controls shall be located on the power unit to allow the power unit to be carried and operated by personnel wearing gloves that are certified as compliant with the glove requirements of NFPA 1971.

N **5.4.7.6** Each power unit with a continuously operating prime mover shall be equipped with a manually operated pressure dump valve to relieve hose line pressure to allow a tool to be removed or attached while the prime mover is operating at full speed.

N **5.4.7.7** All power units shall have all integral control parts labeled to ensure ease of identification by the user, including, but not limited to, the following:

(1) Start switch or control
(2) Stop switch or control
(3) Choke location and position, if applicable
(4) Throttle, if applicable
(5) Fuel or power shutoff
(6) Open and closed position of any dump valve

N **5.4.7.8** All labeling of the prime mover, as specified by the prime mover manufacturer, shall be included.

N **5.4.7.9** Where the power unit includes an internal combustion prime mover, the appropriate engine fuel and engine oil reservoirs shall be indicated by a label.

N **5.4.7.10** Where the power unit includes an internal combustion prime mover, the manufacturer shall provide a label on the power unit that indicates the correct proportions for the fuel/oil mixture, if applicable.

N **5.4.7.11** Where the power unit includes an electric prime mover, the manufacturer shall provide a label on the power unit that indicates the rated horsepower, speed (rpm), amperage, and voltage.

N **5.4.7.12** Where the power unit includes a pneumatic prime mover, the manufacturer shall provide a label on the power unit that indicates the proper air pressure and cubic feet per minute necessary to maintain the specified rated power unit performance.

N **5.4.7.13** Where the power unit includes a hydraulic prime mover, the manufacturer shall provide a label on the power unit that indicates the hydraulic pressure and flow necessary to maintain the specified rated power unit performance.

N **5.4.7.14** The rescue tool manufacturer shall provide the purchaser with any maintenance tools that are not commercially available and that are necessary to perform the expected service and maintenance of the power unit.

N **5.4.7.15** Where hydraulic fluid is used, a hydraulic fluid reservoir shall be provided and have an unobstructed port(s) for adding hydraulic fluid to the reservoir or for draining hydraulic fluid from the reservoir.

N **5.4.7.16** Where hydraulic fluid is used, a label shall be provided near the hydraulic fluid fill port that indicates the type of fluid that is specified by the manufacturer for use with the system.

N **5.4.7.17** The power unit manufacturer shall label the usable capacity of the hydraulic fluid reservoir.

N **5.4.7.18** All power units that weigh in excess of 22.5 kg (49 lb), including fluid, and all power units with an internal

combustion engine shall be provided with an unobstructed port at the lowest point of the hydraulic fluid reservoir to allow the reservoir to be emptied when the power unit is in the upright position.

N **5.4.7.19 Fluid Level.**

N **5.4.7.19.1** Where hydraulic fluid is used, the hydraulic fluid reservoir shall be provided with a means to visually determine the fluid level.

N **5.4.7.19.2** Such means shall include, but not be limited to, dip stick–type indicators, sight gauges, or remote fluid level gauges.

N **5.4.7.20** Where hydraulic fluid is used, the power unit hydraulic pump intake shall be provided with a filter screen.

N **5.4.7.21** The hydraulic pump shall be equipped with a pressure relief device.

N **5.4.7.22** Any pressure relief automatic limiting device shall be designed to deter its adjustment by the user.

N **5.4.7.23** All power unit electrical connectors shall be rated to handle the electrical current realized when the system is operating at rated system input.

N **5.4.7.24** Where an enclosure as part of the rescue tool or rescue tool component is provided for a battery or battery cell, the enclosure shall be vented to permit the circulation of air for dispersion of gases that can be generated under abnormal battery or battery cell or charging conditions.

N **5.4.7.25** Where an enclosure as part of the rescue tool or rescue tool component is provided for a battery or battery cell, the enclosure shall be provided with means of heat transfer, such as ventilation openings or heat sinks, located so as to prevent thermal runaway of the battery or battery cell during normal charging at the maximum allowable ambient temperature as specified by the battery or battery cell manufacturer.

N **5.4.7.26** Power units that use batteries shall provide an indicator or other means to visually check the battery's state of charge.

N **5.4.7.27** All battery or battery pack exposed live terminals shall provide a means to prevent accidental contact and arcing when not being used.

N **5.4.7.28** All electric components shall be listed and labeled for their intended application.

N **5.4.7.28.1** Where listed and labeled electric components are not available for a specific application, the electric components that are used shall be evaluated for the intended application.

N **5.4.7.29** All electric prime movers that are rated at greater than 100 V ac shall provide for an electric ground.

N **5.4.7.30** All portable internal combustion prime movers that are equipped with an electric starter shall also be equipped with a mechanical starter as a backup.

N **5.4.7.31** All portable internal combustion prime movers shall be equipped with a spark-arresting muffler that meets the requirements of the U.S. Department of Agriculture Forest Service as well as a guard to prevent accidental contact with the muffler.

N **5.4.7.32** All internal combustion prime mover crankcases shall be equipped with an unobstructed port to allow oil to be drained without removing the internal combustion prime mover from the power unit.

N **5.4.7.33** All internal combustion prime movers shall have unobstructed access to the fuel tank fill cap and, where applicable, to the oil cap.

N **5.4.7.34** All pneumatic prime movers shall be equipped with an automatically resetting pressure relief device to prevent overpressurizing the pneumatic system.

N **5.4.7.35** The length, width, and height dimensions of the power unit, as supplied by the power unit manufacturer, shall be verified by the third-party certification organization.

N **5.4.7.36** The weight of the ready-to-use power unit, including any necessary attachments, as supplied by the power unit manufacturer, shall be verified by the third-party certification organization, including the batteries and the maximum specified quantities of all fluids including hydraulic fluid, fuel, and engine oil, if applicable.

N **5.5 Performance Requirements.**

N **5.5.1 Spreaders.**

N **5.5.1.1 Operating Temperature Test.**

N **5.5.1.1.1** Spreaders shall be tested for operating temperature range as specified in 5.6.1.

N **5.5.1.1.2** Spreaders shall operate for five operational cycles during operating temperature testing.

N **5.5.1.1.3** Spreaders shall perform without any defect or leak during operating temperature testing.

N **5.5.1.2** Spreaders shall be tested for their ability to hold spreading force as specified in 5.6.6, and not have a creep value greater than 5 mm ($^3/_{16}$ in.) at 9 minutes.

N **5.5.1.3** Where spreaders are also rated for pulling, those spreaders shall be tested for the ability to hold the pulling force as specified in 5.6.7, and not have a creep value greater than 5 mm ($^3/_{16}$ in.) at 9 minutes.

N **5.5.1.4 Spreading Force Test.**

N **5.5.1.4.1** Spreaders shall be tested for spreading forces generated as specified in 5.6.2.

N **5.5.1.4.2** The spreading force at each of the 10 test points shall be at least 8900 N (2000 lbf).

N **5.5.1.4.3** The calculated lowest spreading force (LSF) of all 10 test points shall be designated as the LSF for that specific tool.

N **5.5.1.4.4** The calculated highest spreading force (HSF) of all 10 test points shall be designated as the HSF for that specific tool.

N **5.5.1.5** Where spreaders are also rated for pulling, those spreaders shall be tested for pulling forces generated as specified in 5.6.4, and have the pulling force at each of the 10 test points be at least 7120 N (1600 lbf).

N **5.5.1.5.1** The lowest recorded pulling force of all 10 test points shall be designated as the lowest pulling force (LPF) for that specific tool.

N **5.5.1.5.2** The highest recorded pulling force of all 10 test points shall be designated as the highest pulling force (HPF) for that specific tool.

N 5.5.1.6 Spreaders shall be tested for endurance as specified in 5.6.8, and not have a creep value greater than 5 mm (3/16 in.) at 9 minutes.

N 5.5.1.7 Hydrostatic and Mechanical Overload Test.

N 5.5.1.7.1 Spreaders shall be tested for hydrostatic and mechanical overload as specified in 5.6.9 and include the following:

(1) Spreaders shall not exhibit any functional damage.
(2) Spreaders shall generate the HSF, ±8 percent, for the tool as determined in 5.5.1.4.
(3) Spreaders shall have the deadman control automatically return to the neutral position.

N 5.5.1.7.2 Where spreaders are also rated for pulling, those spreaders shall also generate the HPF, ±8 percent, for the tool as determined in 5.5.1.5.

N 5.5.1.8 The deadman control of spreaders shall be tested for endurance as specified in 5.6.10.

N 5.5.1.8.1 The spreader shall generate the HSF, ±8 percent, for the tool as determined in 5.5.1.4.

N 5.5.1.8.2 The spreader shall not have a creep value greater than 5 mm (3/16 in.) at 9 minutes.

N 5.5.1.8.3 Where a spreader is also rated for pulling, it shall also generate the HPF, ±8 percent, for the tool as determined in 5.5.1.5.

N 5.5.1.9 Where spreaders are equipped with a built-in automatic safety relief device in accordance with 5.4.1.5, spreaders shall be tested for proper functioning of the tool and the built-in safety relief device as specified in 5.6.11, and for operating as specified in 5.5.1.2.

N 5.5.2 Rams.

N 5.5.2.1 Operating Temperature Test.

N 5.5.2.1.1 Rams shall be tested for operating temperature range as specified in 5.6.1.

N 5.5.2.1.2 Rams shall operate for five operational cycles.

N 5.5.2.1.3 Rams shall perform without any defect or leak.

N 5.5.2.2 Rams shall be tested for ability to hold spreading force as specified in 5.6.6, and not have a creep value greater than 5 mm (3/16 in.) at 9 minutes.

N 5.5.2.3 Where rams are also rated for pulling, those rams shall be tested for ability to hold pulling force as specified in 5.6.7, and not have a creep value greater than 5 mm (3/16 in.) at 9 minutes.

N 5.5.2.4 Rams shall be tested for ability to hold spreading force during reconnection of the supply hose or electrical cables as specified in 5.6.6, and not have the creep value exceed 6 mm (1/4 in.) before spreading begins again.

N 5.5.2.5 Rams shall be tested for spreading forces generated as specified in 5.6.3, and have the spreading force at each of the three test points be at least 8900 N (2000 lbf).

N 5.5.2.5.1 The lowest recorded spreading force of all three test points shall be designated as the LSF for that specific tool.

N 5.5.2.5.2 The highest recorded spreading force of all three test points shall be designated as the HSF for that specific tool.

N 5.5.2.6 Where rams are also rated for pulling, those rams shall be tested for pulling forces generated as specified in 5.6.5, and have the pulling force at each of the three test points be at least 7120 N (1600 lbf).

N 5.5.2.6.1 The lowest recorded pulling force of all three test points shall be designated as the LPF for that specific tool.

N 5.5.2.6.2 The highest recorded pulling force of all three test points shall be designated as the HPF for that specific tool.

N 5.5.2.7 Rams shall be tested for endurance as specified in 5.6.8, and not have a creep value greater than 5 mm (3/16 in.) at 9 minutes.

N 5.5.2.8 Hydrostatic and Mechanical Overload Test.

N 5.5.2.8.1 Rams shall be tested for hydrostatic and mechanical overload as specified in 5.6.9 and include the following:

(1) Rams shall not show any functional damage.
(2) Rams shall generate the HSF, ±8 percent, for the tool as determined in 5.5.2.5.
(3) Rams shall have the deadman control automatically return to the neutral position.

N 5.5.2.8.2 Where rams are also rated for pulling, those rams shall also generate the HPF, ±8 percent, for the tool as determined in 5.5.2.6.

N 5.5.2.9 The deadman control of rams shall be tested for endurance as specified in 5.6.10.

N 5.5.2.9.1 Rams shall not have a creep value greater than 5 mm (3/16 in.) at 9 minutes.

N 5.5.2.9.2 Where rams are also rated for pulling, those rams shall also generate the HPF, ±8 percent, for the tool as determined in 5.5.2.6.

N 5.5.2.10 Bending Resistance Test.

N 5.5.2.10.1 Rams shall be tested for bending resistance as specified in 5.6.12 and shall include the following:

(1) Rams shall not exhibit any sign of external leakage or functional damage.
(2) Rams shall generate the HSF, ±8 percent, for the tool as determined in 5.5.2.5.

N 5.5.2.10.2 Where rams are also rated for pulling, those rams shall also generate the HPF, ±8 percent, for the tool as determined in 5.5.2.6.

N 5.5.2.11 Where rams are equipped with a built-in automatic safety relief device in accordance with 5.4.1.5, rams shall be tested for correct functioning of the tool and the safety relief device as specified in 5.6.11, and for operating as specified in 5.5.2.2.

N 5.5.3 Combination Tools.

N 5.5.3.1 Operating Temperature Test.

N 5.5.3.1.1 Combination tools shall be tested for operating temperature range as specified in 5.6.1.

N 5.5.3.1.2 Combination tools shall operate for five operational cycles during operating temperature testing.

N 5.5.3.1.3 Combination tools shall perform without any defect or leak during operating temperature testing.

N **5.5.3.2** Combination tools shall be tested for their ability to hold spreading force as specified in 5.6.6, and not have a creep value greater than 5 mm (3/16 in.) at 9 minutes.

N **5.5.3.3** Where combination tools are also rated for pulling, those combination tools shall be tested for ability to hold pulling force as specified in 5.6.7, and not have a creep value greater than 5 mm (3/16 in.) at 9 minutes.

N **5.5.3.4** Combination tools shall be tested for their ability to cut through the materials as specified in 5.6.13, and cut the material in each material category at a minimum of Level 1 performance.

N **5.5.3.4.1** The combination tool cutter shall receive a separate level rating for each material category as determined by 12 pieces of the largest size material, indicated by the highest numerical performance level that the cutter is able to cut consecutively.

N **5.5.3.4.2*** The minimum total number of qualified cuts that are required for certification shall be 60.

N **5.5.3.4.3** For each cut, the cutter shall completely sever the material in a single continuous motion.

N **5.5.3.4.4*** The level rating for the cutter shall be expressed as specified in 5.4.4.4.2.

N **5.5.3.4.5** It shall be assumed that the cutter is capable of cutting all performance levels below its rated level in any specific materials category.

N **5.5.3.5 Integrity Test.**

N **5.5.3.5.1** All mechanical parts of the cutter shall be tested for product integrity as specified in 5.6.14 and the following:

(1) Cutters shall sustain the maximum load that can be imparted from the force generated by the tool without damage.
(2) Cutters shall operate and cut.

N **5.5.3.5.2** For each cut, the cutter shall completely sever the material in a single continuous motion.

N **5.5.3.6** Combination tools shall be tested for spreading forces generated as specified in 5.6.2, and the spreading force at each of the 10 test points be at least 8900 N (2000 lbf).

N **5.5.3.6.1** The lowest recorded spreading force of all 10 test points shall be designated as the LSF for that specific tool.

N **5.5.3.6.2** The highest recorded spreading force of all 10 test points shall be designated as the HSF for that specific tool.

N **5.5.3.7** Combination tools shall be tested for pulling forces generated as specified in 5.6.4, and have the pulling force at each of the 10 test points be at least 7120 N (1600 lbf).

N **5.5.3.7.1** The lowest recorded pulling force of all 10 test points shall be designated as the LPF for that specific tool.

N **5.5.3.7.2** The highest recorded pulling force of all 10 test points shall be designated as the HPF for that specific tool.

N **5.5.3.8** Combination tools shall be tested for endurance as specified in 5.6.8, and not have a creep value greater than 5 mm (3/16 in.) at 9 minutes.

N **5.5.3.9 Overload Test.**

N **5.5.3.9.1** Combination tools shall be tested for overload as specified in 5.6.9 and include the following:

(1) Combination tools shall not fail overload testing.
(2) Combination tools shall generate the HSF, ±8 percent, for the tool as determined in 5.5.3.6.

N **5.5.3.9.2** Where combination tools are also rated for pulling, those combination tools shall also generate the HPF, ±8 percent, for the tool as determined in 5.5.3.7.

N **5.5.3.10 Deadman Control Endurance Test.**

N **5.5.3.10.1** The deadman control of combination tools shall be tested for endurance as specified in 5.6.10, and not have a creep value greater than 5 mm (3/16 in.) at 9 minutes.

N **5.5.3.10.2** Where combination tools are also rated for pulling, those combination tools shall also generate the HPF, ±8 percent, for the tool as determined in 5.5.3.7.

N **5.5.3.11** Where combination tools are equipped with a built-in automatic safety relief device in accordance with 5.4.1.5, combination tools shall be tested for correct functioning of the tool and the safety relief device as specified in 5.6.11, and operate as specified in 5.5.3.2.

N **5.5.3.12** Where combination tools are also rated for cutting high-strength materials, the cutters of those combination tool shall be tested for their ability to cut through the materials as specified in 5.6.15.

N **5.5.3.12.1** It shall not be required for the same combination tool used in 5.6.13 to be used in 5.6.15.

N **5.5.3.12.2** The combination tool shall receive a level rating as determined by six pieces of the largest size material, indicated by the highest performance level, that the cutter of the combination tool is able to cut consecutively.

N **5.5.3.12.3** For each cut, the combination tool shall completely sever the material in a single continuous motion.

N **5.5.3.12.4** The level rating for the combination tool shall be expressed as specified in 5.4.4.6.2.

N **5.5.3.12.5** It shall be assumed that the combination tool is capable of cutting all performance levels below its rated level.

N **5.5.4 Cutters.**

N **5.5.4.1 Operating Temperature Test.**

N **5.5.4.1.1** Cutters shall be tested for operating temperature range as specified in 5.6.1.

N **5.5.4.1.2** Cutters shall operate for five operational cycles during operating temperature testing.

N **5.5.4.1.3** Cutters shall perform without any defect or leak during operating temperature testing.

N **5.5.4.2** Cutters shall be tested for their ability to cut through the materials as specified in 5.6.13, as well as the material in each material category at a minimum of Level 1 performance.

N **5.5.4.2.1** The cutter shall receive a separate level rating for each material category as determined by 12 pieces of the largest size material, indicated by the highest numerical performance level, that the cutter is able to cut consecutively.

N **5.5.4.2.2*** The minimum total number of qualified cuts that are required for certification shall be 60.

N **5.5.4.2.3** For each cut, the cutter shall completely sever the material in a single continuous motion.

N **5.5.4.2.4*** The level rating for the cutter shall be expressed as specified in 5.4.5.3.2.

N **5.5.4.2.5** It shall be assumed that the cutter is capable of cutting all performance levels below its rated level in any specific materials category.

N **5.5.4.3 Integrity Test.**

N **5.5.4.3.1** All mechanical parts of the cutter shall be tested for product integrity as specified in 5.6.14 and include the following:

(1) The cutter shall sustain the maximum load that can be imparted from the force generated by the tool without damage.
(2) The cutter shall operate and cut.

N **5.5.4.3.2** For each cut, the cutter shall completely sever the material in a single continuous motion.

N **5.5.4.4** The deadman control of cutters shall be tested for endurance as specified in 5.6.10 and include the following:

(1) The deadman control shall automatically return to neutral.
(2) The cutter shall develop the rated system input.

N **5.5.4.5** Where cutters are equipped with a built-in automatic safety relief device in accordance with 5.4.1.5, cutters shall be tested for functioning of the tool and the safety relief device as specified in 5.6.11 and include the following:

(1) The cutters shall operate without any sign of permanent damage, defect, or leaks.
(2) The cutter's safety relief device shall automatically reset.

N **5.5.4.6** Where cutters are also rated for cutting high-strength materials, those cutters shall be tested for their ability to cut through the materials as specified in 5.6.15.

N **5.5.4.6.1** It shall not be required for the same cutter used in 5.6.13 to be used in 5.6.15.

N **5.5.4.6.2** The cutter shall receive a level rating as determined by six pieces of the largest size material, indicated by the highest performance level, that the cutter is able to cut consecutively.

N **5.5.4.6.3** For each cut, the cutter shall completely sever the material in a single continuous motion.

N **5.5.4.6.4** The level rating for the cutter shall be expressed as specified in 5.4.5.5.2.

N **5.5.4.6.5** It shall be assumed that the cutter is capable of cutting all performance levels below its rated level.

N **5.5.5 Hose Assemblies.** Hose assemblies shall be proof pressure tested as specified in 5.6.26, and not leak or rupture.

N **5.5.6 Power Units.**

N **5.5.6.1** Where power units are tested using the rated system input, the rated system input shall have a tolerance ±5 percent.

N **5.5.6.2** The power unit shall be tested for impact resistance as specified in 5.6.16 and develop the rated system input of a rescue tool during each of five operational cycles.

N **5.5.6.3** The power unit shall be tested for noise production as specified in 5.6.17, and not exceed 83 dBA at 4 m (13 ft).

N **5.5.6.4** The power unit shall be tested for operation on an incline as specified in 5.6.18 and power a rescue tool through a complete operational cycle to the rated system input of the rescue tool.

N **5.5.6.5** The power unit hydraulic pump shall be tested for its ability to maintain rated system input as specified in 5.6.19 and maintain the rated system input for at least 1 minute.

N **5.5.6.6** The power unit output pressure relief or automatic limiting device shall be tested for proper operation as specified in 5.6.20 and prevent the power unit output from achieving greater than 105 percent of the rated system input.

N **5.5.6.7** The manually operated dump valve of power units shall be tested for proper operation as specified in 5.6.21, and allow hose to be disconnected from and reconnected to the power unit.

N **5.5.6.8** Power units shall be tested for endurance as specified in 5.6.22 and include the following:

(1) Power units shall operate normally.
(2) Power units shall not leak.

N **5.5.6.9** Directional valves on power units, where provided, shall be tested for endurance as specified in 5.6.23 and include the following:

(1) Directional valves shall operate normally.
(2) Directional valves shall not leak.

N **5.5.7 Remote Valve Blocks and Hose Reels.**

N **5.5.7.1** Remote valve blocks shall be tested for endurance as specified in 5.6.24 and include the following:

(1) Remote valve blocks shall operate as intended.
(2) Remote valve blocks shall not leak.

N **5.5.7.2 Endurance Test.**

N **5.5.7.2.1** Hose reels shall be tested for endurance as specified in 5.6.25.

N **5.5.7.2.2** Hose reel rotary seals shall not leak.

N **5.6 Testing.**

N **5.6.1 Tool Operating Temperature Test.**

N **5.6.1.1 Temperature Conditioning.**

N **5.6.1.1.1** The tool test specimen, including the power unit designed to be used in conjunction with the specific tool and all hose and cables necessary to connect the power unit to the tool, shall be placed in a temperature-conditioning chamber at −20°C, ±2°C (−4°F, ±4°F) for a minimum of 5 hours.

N **5.6.1.1.2** The 5-hour storage time stated in 5.6.1.1.1 shall begin when the temperature-conditioning chamber has stabilized at −20°C, ±2°C (−4°F, ±4°F) after the tool test specimen has been placed in the chamber.

N 5.6.1.2 Removal from Chamber.

N 5.6.1.2.1 The tool test specimen shall be removed from the temperature-conditioning chamber after being subjected to at least 5 hours at the conditioning temperature.

N 5.6.1.2.2 The tool test specimen shall then be started within 2 minutes of removal from the temperature-conditioning chamber and be operated for five full cycles from the fully open to the fully closed position at rated system input.

N 5.6.1.3 The tool test specimen, power unit, hose, and cables shall be observed for defects and leaks while the tool test specimen is in operation.

N 5.6.1.4 Dwell Time.

N 5.6.1.4.1 After a 12-hour minimum dwell time, the same tool test specimen, including the power unit designed to be used in conjunction with the specific tool and all hose and cables necessary to connect the power unit to the tool, shall then be stored in a temperature-conditioning chamber at 49°C, ±2°C (120°F, ±4°F) for a minimum of 5 hours.

N 5.6.1.4.2 The 5-hour storage time stated in 5.6.1.4.1 shall begin when the temperature-conditioning chamber has stabilized at 49°C, ±2°C (120°F, ±4°F) after the tool test specimen has been placed in the chamber.

N 5.6.1.5 Second Removal from Chamber.

N 5.6.1.5.1 The tool test specimen shall be removed from the temperature-conditioning chamber after being subjected to at least 5 hours at the conditioning temperature.

N 5.6.1.5.2 The tool test specimen shall then be started within 2 minutes of removal from the temperature-conditioning chamber and be operated for five full cycles from the fully open to the fully closed position at rated system input.

N 5.6.1.6 The tool test specimen, power unit, hose, and cables shall be observed for defects and leaks while the tool test specimen is in operation.

N 5.6.1.7 The results of observation of all test cycles shall be used to determine pass/fail.

N 5.6.1.8 During any of the test cycles, any operational abnormalities, defects, or leaks in the tool, power unit, hose, or cables shall constitute failure.

N 5.6.2 Spreading Force Test.

N 5.6.2.1 The spreading forces of tool test specimens shall be measured using the tips normally supplied to the purchaser or user.

N 5.6.2.2 A test fixture shall be provided that allows the tool test specimen to move through its full operational cycle.

N 5.6.2.3 The test fixture shall be equipped with a calibrated force-measuring device, with a minimum accuracy of ±0.5 percent of the total scale reading, to record the forces developed.

N 5.6.2.4 Test Setup.

N 5.6.2.4.1 The general test setup shall be as shown in Figure 5.6.2.4.1(a) or Figure 5.6.2.4.1(b), as applicable.

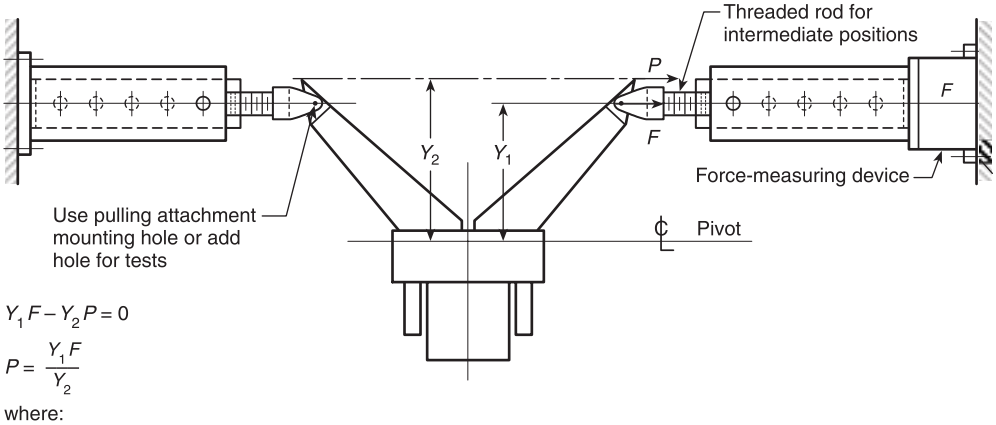
N 5.6.2.4.2 Equivalent test setups that use the same concepts as shown in Figure 5.6.2.4.1(a) or Figure 5.6.2.4.1(b) shall be permitted.

N 5.6.2.4.3 The test points shall be the existing holes in the tool for pulling attachments.

N 5.6.2.4.4 Where there are no pulling attachment holes in the tool or test attachments supplied by the manufacturer, holes shall be made for conducting this test.

N 5.6.2.5 The tool test specimen shall be operated at the rated system input of the tool.

N 5.6.2.6 The spreading force exerted by the tool test specimen shall be measured and recorded at 10 uniformly spaced intervals that range from the fully closed position to 95 percent of the fully open position.



$Y_1 F - Y_2 P = 0$

$P = \frac{Y_1 F}{Y_2}$

where:

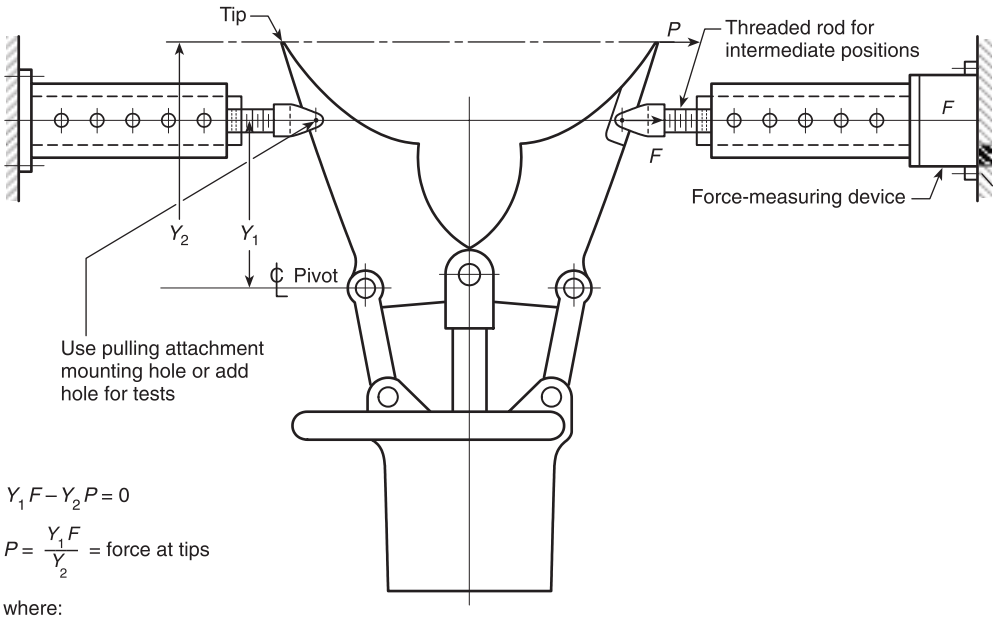
Y_1 = moment arm length of the measured force F

F = measured force at the attachment points

Y_2 = moment arm length of the calculated force P

P = calculated force at the tips

N FIGURE 5.6.2.4.1(a) Test Fixture to Determine Spreading and Retracting Forces of Spreaders.



$Y_1 F - Y_2 P = 0$

$P = \frac{Y_1 F}{Y_2}$ = force at tips

where:
Y_1 = moment arm length of the measured force F
F = measured force at the attachment points
Y_2 = moment arm length of the calculated force P
P = calculated force at the tips

N FIGURE 5.6.2.4.1(b) Test Fixture to Determine Spreading and Retracting Forces of Combination Tools.

N 5.6.2.7 The recorded spreading forces shall be used to calculate the spreading force at the tool tip using the following formula:

[5.6.2.7]

$$P = \frac{Y_1 F}{Y_2}$$

where:
P = calculated force at the tips
Y_1 = moment arm length of the measured force F
F = measured force at the attachment points
Y_2 = moment arm length of the calculated force P

N 5.6.2.8 Any calculated spreading force at the tool tips less than 8900 N (2000 lbf) shall constitute failure.

N 5.6.2.9 The calculated spreading forces at the tool tips shall be reviewed to determine the lowest spreading force (LSF) and highest spreading force (HSF) designations, respectively.

N 5.6.2.10 The calculated spreading forces at the tool tips shall be the reported forces that are required by 5.5.1.4 and 5.5.3.6.

N 5.6.3 Ram Tool Spreading Force Test.

N 5.6.3.1 The spreading forces of the tool test specimens shall be measured using the tips normally supplied to the purchaser or user.

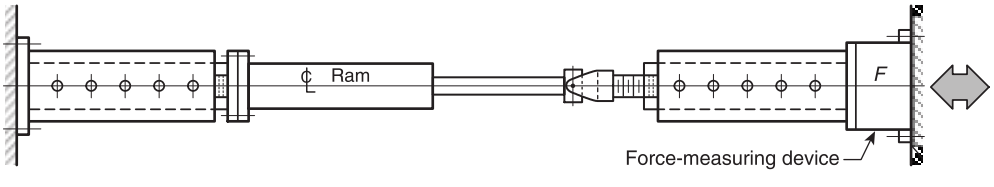
N 5.6.3.2 A test fixture shall be provided.

N 5.6.3.2.1 The test fixture shall be equipped with a force-measuring device and allow the tool test specimen to move through its full operational cycle.

N 5.6.3.2.2 The test fixture shall be equipped with a calibrated force-measuring device, with a minimum accuracy of ±0.5 percent of the total scale reading, to record the forces developed.

N 5.6.3.3 Test Setup.

N 5.6.3.3.1 The general test setup shall be as shown in Figure 5.6.3.3.1, as applicable.



F = measured force at attachment points

N FIGURE 5.6.3.3.1 Test Fixture to Determine Extension and Retraction Forces of Rams.

N **5.6.3.3.2** Equivalent test setups that use the same concept as shown in Figure 5.6.3.3.1 shall be permitted.

N **5.6.3.3.3** The test points shall be the existing holes in the tool for pulling attachments.

N **5.6.3.3.4** Where there are no pulling attachment holes in the tool, holes shall be made for conducting this test.

N **5.6.3.4** The ram tool test specimen shall be operated at the rated system input of the tool.

N **5.6.3.5** The spreading force exerted by the ram shall be measured and recorded at three uniformly spaced intervals that range from the fully closed position to 95 percent of the fully open position.

N **5.6.3.6 Pass/Fail.**

N **5.6.3.6.1** The recorded spreading forces shall be reviewed to determine pass/fail.

N **5.6.3.6.2** Any recorded spreading force less than 8900 N (2000 lbf) shall constitute failure.

N **5.6.3.7** The recorded spreading forces shall be reviewed to determine the LSF and HSF designations, respectively.

N **5.6.3.8** The recorded spreading forces at the tool tips shall be the reported forces required by 5.5.2.5.

N **5.6.4 Spreader Tool Pulling Force Test.**

N **5.6.4.1** The pulling forces of tool test specimens shall be measured using the tips normally supplied to the purchaser or user.

N **5.6.4.2** A test fixture shall be provided that allows the tool test specimen to move through its full operational cycle.

N **5.6.4.3** The test fixture shall be equipped with a calibrated force-measuring device, with a minimum accuracy of ±0.5 percent of the total scale reading, to record the forces developed.

N **5.6.4.4 Test Setup.**

N **5.6.4.4.1** The general test setup shall be as shown in Figure 5.6.2.4.1(a) or Figure 5.6.2.4.1(b), as applicable.

N **5.6.4.4.2** Equivalent test setups that use the same concept as shown in Figure 5.6.2.4.1(a) or Figure 5.6.2.4.1(b) shall be permitted.

N **5.6.4.5** The test points shall be the standard production pulling attachment points on the rescue tool.

N **5.6.4.6** The tool test specimen shall be operated at the rated system input of the tool.

N **5.6.4.7** The pulling force exerted by the tool test specimen shall be measured and recorded at 10 uniformly spaced intervals that range from the fully open position to 95 percent of the fully closed position.

N **5.6.4.8** The reported pulling forces at the tool tips shall be reviewed to determine pass/fail and to determine the lowest pulling force (LPF) and highest pulling force (HPF) designations, respectively.

N **5.6.4.9** The recorded pulling forces shall be the reported forces required by 5.5.1.5 and 5.5.3.7.

N **5.6.5 Ram Tool Pulling Force Test.**

N **5.6.5.1** The pulling forces of tool test specimens shall be measured using the tips normally supplied to the purchaser or user.

N **5.6.5.2** A test fixture shall be provided.

N **5.6.5.2.1** The test fixture shall be equipped with a force-measuring device and allow the tool test specimen to move through its full operational cycle.

N **5.6.5.2.2** The test fixture shall be equipped with a calibrated force-measuring device, with a minimum accuracy of ±0.5 percent of the total scale reading, to record the forces developed.

N **5.6.5.3 Test Setup.**

N **5.6.5.3.1** The general test setup shall be as shown in Figure 5.6.3.3.1, as applicable.

N **5.6.5.3.2** Equivalent test setups of the same concept as shown in Figure 5.6.3.3.1 shall be permitted.

N **5.6.5.4** The test points shall be the standard production pulling attachment points on the rescue tool.

N **5.6.5.5** The ram tool test specimen shall be operated at the rated system input of the tool.

N **5.6.5.6** The pulling force exerted by the ram shall be measured and recorded at three uniformly spaced intervals that range from the fully open position to 95 percent of the fully closed position.

N **5.6.5.7** The recorded pulling forces shall be reviewed to determine pass/fail and the LPF and HPF designations, respectively.

N **5.6.5.8** The recorded pulling forces at the tool tips shall be the reported forces required by 5.5.2.6.

N **5.6.6 Spreading Force Sudden Power Loss Test.**

N **5.6.6.1** Tool test specimens shall be placed in the test fixture exactly as for the spreading force test specified in 5.6.2 or 5.6.3, as applicable for the specific tool test specimen.

N **5.6.6.2** Tool test specimens shall be set at the HSF position and be subjected to an external load equal to the greatest spreading force measured in the respective spreading force test, ±2 percent.

N **5.6.6.3** The pressure supply hose or electric cable that supplies the tool test specimen shall then be disconnected from the tool to simulate a sudden power loss, and any creep of the tool test specimen be measured.

N **5.6.6.3.1** Where the tool test specimen is not equipped with a control, the creep shall be measured at 9 minutes.

N **5.6.6.3.2** Where the tool test specimen is equipped with a control, the control shall be set at each setting during the test.

N **5.6.6.3.2.1** The control setting shall be set for 3 minutes at fully open, 3 minutes at fully closed, and 3 minutes at neutral.

N **5.6.6.3.2.2** The creep shall be measured at 9 minutes.

N **5.6.6.4 Pass/Fail.**

N **5.6.6.4.1** The measured creep shall be evaluated to determine pass/fail.

N **5.6.6.4.2** Any creep that exceeds the requirement shall constitute failure.

N **5.6.7 Pulling Force Sudden Power Loss Test.**

N **5.6.7.1** Tool test specimens shall be placed in the test fixture exactly as for the pulling force test specified in 5.6.4 or 5.6.5, as applicable for the specific tool test specimen.

N **5.6.7.2** Tool test specimens shall be set at the HPF position and be subjected to an external load equal to the greatest pulling force measured in the respective pulling force test, ±2 percent.

N **5.6.7.3** The pressure supply hose or electric cable that supplies the tool test specimen shall then be disconnected from the tool to simulate a sudden power loss, and any creep of the tool test specimen be measured.

N **5.6.7.3.1** The tool test specimen control shall be set at each setting during the test.

N **5.6.7.3.2** The control setting shall be set for 3 minutes at fully open, 3 minutes at fully closed, and 3 minutes at neutral.

N **5.6.7.3.3** The creep shall be measured at 9 minutes.

N **5.6.7.4 Pass/Fail.**

N **5.6.7.4.1** The measured creep shall be evaluated to determine pass/fail.

N **5.6.7.4.2** Any creep that exceeds the requirement at 9 minutes shall constitute failure.

N **5.6.8 Dynamic Endurance Test.**

N **5.6.8.1** A test fixture shall be provided that allows the tool test specimen to move through its full operational cycle.

N **5.6.8.2** The test fixture shall be equipped with a calibrated force-measuring device, with a minimum accuracy of ±0.5 percent of the total scale reading, to record the forces developed.

N **5.6.8.3 Test Setup.**

N **5.6.8.3.1** The general test setup shall be as shown in Figure 5.6.2.4.1(a) or Figure 5.6.2.4.1(b), as applicable.

N **5.6.8.3.2** Equivalent test setups that use the same concept as shown in Figure 5.6.2.4.1(a) or Figure 5.6.2.4.1(b) shall be permitted.

N **5.6.8.4** Cooling of the hydraulic fluid, electric motor, and electric switches shall be permitted during this test.

N **5.6.8.5** The tool test specimens for spreading and pulling shall undergo 1000 continual operational cycles while under a spreading load equal to 80 percent of the LSF and while under a pulling load equal to 80 percent of the LPF, as defined in 5.5.1.4, 5.5.1.5, 5.5.2.5, 5.5.2.6, 5.5.3.6, or 5.5.3.7, as applicable for the specific tool test specimen.

N **5.6.8.5.1** A pause in the continual operational cycles for lubrication shall be permitted.

N **5.6.8.5.2** The continual operational cycles shall not be interrupted for maintenance other than as allowed by 5.6.8.5.1.

N **5.6.8.6** The tool test specimens shall then be placed in the same test fixture exactly as for the load test specified in 5.6.2 or 5.6.3, as applicable for the specific tool test specimen.

N **5.6.8.6.1** Tool test specimens shall be subjected to a test load equal to 110 percent of the HSF of the specific tool.

N **5.6.8.6.2** Where tools also are rated for pulling, those tool test specimens shall also be subjected to a test load equal to 110 percent of the HPF of the specific tool.

N **5.6.8.7** The pressure supply hose or electrical cables supplying the tool test specimen shall then be disconnected from the tool to simulate a sudden power loss, and any creep of the tool test specimen shall be measured.

N **5.6.8.7.1** Where the tool test specimen is not equipped with a control, the creep shall be measured at 9 minutes.

N **5.6.8.7.2** Where the tool test specimen is equipped with a control, the control shall be set at each setting during the test.

N **5.6.8.7.2.1** The control setting shall be set for 3 minutes at fully open, 3 minutes at fully closed, and 3 minutes at neutral.

N **5.6.8.7.2.2** The creep shall be measured at 9 minutes.

N **5.6.8.8 Pass/Fail.**

N **5.6.8.8.1** The measured creep shall be evaluated to determine pass/fail.

N **5.6.8.8.2** Any creep that exceeds the requirement at 9 minutes shall constitute failure.

N **5.6.9 Overload Test.**

N **5.6.9.1** While the tool test specimen is in the test fixture used for the test specified in 5.6.2 or 5.6.3, as applicable for the specific tool test specimen, a test load equal to 150 percent of the HSF and HPF, as applicable, shall be applied as stated in 5.6.9.1.1 through 5.6.9.1.3 for one minute.

N **5.6.9.1.1** For rescue tools having external pressure supply and return ports, the test load shall be achieved by applying 150 percent of the rated system input.

N **5.6.9.1.2** Rescue tools having self-contained internal pressure supply and return ports (i.e., closed-loop systems) shall be permitted to be tested in accordance with the procedures specified in either 5.6.14.2 or 5.6.14.4.

N **5.6.9.1.3** For rescue tools that do not meet the criteria of 5.6.9.1.1 or 5.6.9.1.2, the test load shall be applied externally.

N **5.6.9.2 Spreader Tool or Combination Test Specimens.**

N **5.6.9.2.1** For spreader tool or combination tool test specimens, the test load shall be applied to the tool at the tip separation producing the HSF as determined in 5.5.1.4 or 5.5.3.6.

N **5.6.9.2.2** Where the tool is also rated for pulling, the test load shall be applied to the tool at the tip separation producing the HPF as determined in 5.5.1.5 or 5.5.3.7.

N **5.6.9.3 Ram Tool Test Specimens.**

N **5.6.9.3.1** For ram tool test specimens, the test load shall be applied to the tool at the tip separation producing the HSF as determined in 5.5.2.5.

N **5.6.9.3.2** Where the ram tool is also rated for pulling, the test load shall be applied to the tool at the tip separation producing the HPF as determined in 5.5.2.6.

N 5.6.9.4 The test results shall be evaluated and the tool test specimen shall be examined and operated to determine pass/fail.

N 5.6.9.4.1 The inability of a tool to produce the HSF or HPF, or both, as applicable, shall constitute failure.

N 5.6.9.4.2 The inability of a tool to be fully operational from the fully open position to the fully closed position back to the fully open position shall constitute failure.

N 5.6.10 Deadman Control Device Endurance Test.

N 5.6.10.1 The deadman control on the tool test specimen shall be subjected to a continual 5000-cycle endurance test during which fluid shall be circulated through the tool, or current applied, so as to cause the tool to move in both the opening and closing directions.

N 5.6.10.1.1 The tool shall be operated a distance equal to no less than 10 percent of the total travel distance of the tool in each direction during each activation.

N 5.6.10.1.2 No external mechanical load, or resistance, shall be applied to the tool.

N 5.6.10.2 A cycle for this test shall be the activation of the control to its hard stop in each direction so as to cause the tool test specimen to move in the opening and closing directions as specified in 5.6.10, and then releasing the control, allowing the control to return to its neutral position.

N 5.6.10.3 Controls.

N 5.6.10.3.1 Where all deadman controls on the tool test specimen are identical, a single test with one tool shall be conducted.

N 5.6.10.3.2 Each different type of deadman control shall be tested separately.

N 5.6.10.4 Following the 5000 cycles, the deadman control shall be evaluated to determine that it has automatically returned to the neutral position.

N 5.6.10.5 For spreaders, rams, and combination tools, the tool test specimen shall then be evaluated in accordance with 5.6.6.

N 5.6.10.5.1 The measured creep shall be evaluated to determine pass/fail.

N 5.6.10.5.2 Any creep that exceeds the requirement at 9 minutes shall constitute failure.

N 5.6.10.5.3 Tool Test Specimen.

N 5.6.10.5.3.1 The tool test specimen shall be examined and operated to determine pass/fail.

N 5.6.10.5.3.2 The inability of a tool to produce the HSF or HPF, or both, as applicable, shall constitute failure.

N 5.6.10.6 For cutters, the tool test specimen shall then be evaluated in accordance with 5.6.14.

N 5.6.11 Safety Relief Device Test.

N 5.6.11.1 The pressure and return lines shall be connected to the tool, and the return line from the tool shall be blocked.

N 5.6.11.2 The power unit shall be activated, and the tool be operated with the piston rod extending for 15 seconds to the rated system input.

N 5.6.11.3 Return Line Blockage.

N 5.6.11.3.1 For spreaders, rams, and combination tools, the return line shall then be unblocked and the tool be tested as specified in 5.6.6.

N 5.6.11.3.2 Testing in accordance with 5.6.8 shall be permitted to be performed only once to evaluate the requirements in both 5.6.6 and 5.6.11.

N 5.6.11.4 For spreaders, rams, and combination tools, pass/fail shall be determined as specified in 5.5.1.2, 5.5.2.2, and 5.5.3.2, respectively.

N 5.6.11.5 For cutters, the return line shall then be unblocked, and the cutter be operated for five complete operational cycles to the rated system input.

N 5.6.11.6 For cutters, pass/fail shall be determined in accordance with 5.5.4.5.

N 5.6.12 Ram Bend Test.

N 5.6.12.1 The ram tool test specimen shall be tested at 95 percent of the full extension as shown in Figure 5.6.12.1.

N 5.6.12.2 An external off-center load equal to 125 percent of the spreading force measured at 95 percent of its full extension in 5.6.3.6 shall be applied to the ram while the ram is extended to 95 percent of its stroke.

N 5.6.12.3 The load shall be applied at a point not more than 13 mm (½ in.) from the farthest edge of the gripping surfaces of the feet and in the same radial plane.

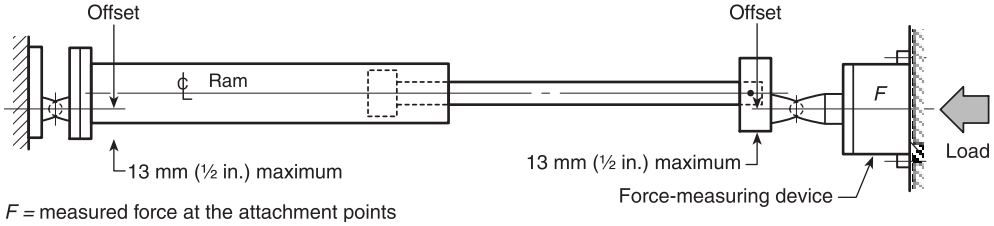
N 5.6.12.4 Leakage.

N 5.6.12.4.1 The tool test specimen shall be examined for leakage to determine pass/fail.

N 5.6.12.4.2 Any leakage shall constitute failure.

N 5.6.12.5 Tool Test Specimen.

N 5.6.12.5.1 The tool test specimen shall be operated to determine pass/fail.



F = measured force at the attachment points

N FIGURE 5.6.12.1 Fixture for Ram Bend Test.

N 5.6.12.5.2 The inability of a tool to produce the HSF or HPF, or both, as applicable, shall constitute failure.

N 5.6.13 Cutting Test.

N 5.6.13.1 The purpose of the cutting test shall be to provide a benchmark for comparison of cutting capabilities as it relates to 5.6.13.3.

N 5.6.13.2 The cutting test shall not be an indication of a cutter's performance in the field.

N 5.6.13.3 The tool test specimen shall be operated to cut 12 pieces of the largest size material, indicated by the highest numerical performance level, which it is capable of cutting for each material category specified in Figure 5.6.13.3.

N 5.6.13.4 Each tool test specimen shall use only one set of blades for this test.

N 5.6.13.5 Cutting shall be permitted to be performed at any area of the blades.

N 5.6.13.6 The minimum total number of qualified cuts required for certification shall be 60; that is, 12 cuts at the same performance level for a single material category and repeated for all material categories.

N 5.6.13.7 The performance level shall be the same for all 12 cuts of a single material category but be permitted to be a different performance level for each material category.

N 5.6.13.8 Each cut shall be observed to determine that the cutter completely severs the material in a single continuous motion to determine pass/fail.

N 5.6.13.9 The number of pieces of material that are cut shall be tabulated to determine pass/fail.

N 5.6.13.10 The performance level at which the cutter cuts each material category shall be recorded and reported to determine the level rating for the cutter.

N 5.6.13.11 The inability of a cutter to cut through the materials at a minimum of performance Level 1 in each of the five material categories shall constitute failure of the cutter.

N 5.6.14 Cutter Integrity Test.

N 5.6.14.1 The tool test specimen shall be operated in accordance with the manufacturer's instructions.

N 5.6.14.2 For rescue tools having external pressure supply and return ports, the cutter shall be pressurized to 150 percent of the rated system input and caused to cut into a steel rod that is beyond the tool's cutting capacity for 1 minute.

N 5.6.14.3 Rescue tools having self-contained internal pressure supply and return ports (i.e., closed-loop systems) shall be permitted to be tested in accordance with the procedures specified in either 5.6.14.2 or 5.6.14.4.

N 5.6.14.4 The rescue tool cutter shall be connected to a force-measuring device and operated at rated system input to cut into steel that is beyond the cutting capacity of the cutter.

N 5.6.14.4.1 The force achieved by the cutter shall be recorded.

N 5.6.14.4.2 With the cutter blades still engaged into the steel, an opposing external force equal to 1.5 times the achieved force shall be applied for 1 minute.

N 5.6.14.5 Following the overload condition, the cutters shall be operated for a single cut of each material category at the performance level for which the cutter is rated.

N 5.6.14.5.1 For each cut, the cutter shall completely sever the material in a single continuous motion.

Material Category	A Round Bar	B Flat Bar	C Round Pipe		D Square Tube	E Angle Iron
						
Material	A-36 Hot-Rolled	A-36	Schedule 40 A-53 Grade B		A-500 Grade	A-36
Performance Level	Diameter (in.)	Thickness × Width (in. × in.)	Nominal size (in.)	OD × Wall Thickness (in. × in.)	Dimension × Wall Thickness (in. × in.)	Square Dimension × Thickness (in. × in.)
1	⅜	¼ × ½	⅜	0.68 × 0.09	½ × 0.06	½ × ⅛
2	½	¼ × 1	¾	1.05 × 0.11	1¾ × 0.06	1 × ⅛
3	⅝	¼ × 2	1	1.32 × 0.13	1 × 0.08	1¼ × 3⁄16
4	¾	¼ × 3	1¼	1.66 × 0.14	1¼ × 0.12	1½ × 3⁄16
5	⅞	¼ × 4	1½	1.90 × 0.15	1½ × 0.12	1½ × ¼
6	1	⅜ × 3	2	2.38 × 0.15	1¾ × 0.12	1¾ × ¼
7	1¼	⅜ × 4	2½	2.88 × 0.20	2 × 0.15	1½ × ⅜
8	1½	⅜ × 5	3	3.50 × 0.22	2½ × 0.19	2 × ⅜
9	1¾	⅜ × 6	3½	4.00 × 0.23	3 × 0.19	2½ × ⅜

For SI units 1 in. = 25.4 mm.

N FIGURE 5.6.13.3 Cut Testing and Level Performance Rating.

N 5.6.14.5.2 Cutting shall be permitted to be performed at any area of the blades.

N 5.6.14.5.3 The power unit shall be returned to the normal operating pressure so that it will not exceed the rated system input pressure needed to perform the following test cuts.

N 5.6.14.6 The cutting process shall be evaluated to determine pass/fail.

N 5.6.15 High-Strength Material Cutting Test.

N 5.6.15.1* This test shall apply only to cutters and combination tools where the manufacturer is rating them for cutting high-strength materials *(see Figure 5.6.15.1)*.

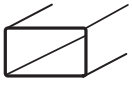
N 5.6.15.2 The cutting test shall be a benchmark for comparison of cutting capabilities as it relates to Figure 5.6.15.1.

N 5.6.15.3 The cutting test shall not be an indication of a cutter's performance in the field.

N 5.6.15.4 Operation.

N 5.6.15.4.1 The tool test specimen shall be operated to cut six pieces of the largest size material, indicated by the highest performance level, that it is capable of cutting as specified in Figure 5.6.15.1.

N 5.6.15.4.2 The cutter blades shall be placed a minimum of 100 mm (3.9 in.) distance from each end of the cut test material.

Material Category	F Rectangular Tube Ultra High-Strength Low-Alloy 	
Material	4130 per AMS 6371 H/T to min 32 HRC Profile per ASTM A519/A519M	
Performance Level	Outside Dimensions × Wall Thickness	
	mm × mm × mm	in. × in. × in.
1	25 × 50 × 1.7	1 × 2 × 0.065
2	25 × 50 × 2.1	1 × 2 × 0.083
3	25 × 50 × 3.04	1 × 2 × 0.120
4	50 × 76 × 3.178	2 × 3 × 0.125
5	50 × 76 × 4.78	2 × 3 × 0.188
6	50 × 101 × 4.78	2 × 4 × 0.188
7	50 × 101 × 6.4	2 × 4 × 0.250

N FIGURE 5.6.15.1 High-Strength Materials Cut and Level Performance Rating.

N 5.6.15.5 Each tool test specimen shall use only one set of blades for this test.

N 5.6.15.6 Cutting shall be permitted to be performed at any area of the blades.

N 5.6.15.7 The minimum number of qualified cuts required to achieve rating for high-strength materials shall be 6.

N 5.6.15.8 Each cut shall be observed to determine that the cutter completely severs the material in a single continuous motion to determine rating for high-strength materials.

N 5.6.15.9 The number of pieces of material that are cut shall be tabulated to determine rating for high-strength materials.

N 5.6.15.10 The performance level at which the material is successfully severed shall be recorded and reported to determine the level rating for the cutter.

N 5.6.15.11 A cutter that is unable to cut the lowest performance level for high-strength materials shall not be rated for cutting high-strength materials.

N 5.6.15.12 The inability of the cutter to cut the lowest performance level shall not constitute failure of the cutter to qualify for certification to this standard.

N 5.6.16 Impact Resistance Test.

N 5.6.16.1 The power unit test specimen shall be suspended in an upright orientation over a solid steel plate that is at least 25 mm (1 in.) thick.

N 5.6.16.2 The power unit test specimen shall be dropped a distance of 610 mm (2 ft) onto the steel plate.

N 5.6.16.3 The power unit test specimen shall then be connected to a tool that is designated for use with the power unit and power the tool through five complete operational cycles of the tool.

N 5.6.16.4 The rated system input of the tool that is achieved while being powered by the power unit test specimen during each of the five cycles shall be recorded to determine pass/fail.

N 5.6.17 Noise Test.

N 5.6.17.1 The test procedure shall be conducted in accordance with ANSI S12.36, *Standard Survey Methods for the Determination of Sound Pressure Levels of Noise Sources.*

N 5.6.17.2 The noise produced by the power unit test specimens shall be measured at a distance of 4 m (13 ft) from the power unit.

N 5.6.17.3 The noise production shall be recorded and evaluated to determine pass/fail.

N 5.6.18 Incline Operational Test.

N 5.6.18.1 Test Specimen.

N 5.6.18.1.1 The power unit test specimen shall be tested while powering a rescue tool with the largest differential oil volume that is capable of being used with the system.

N 5.6.18.1.2 The rescue tool used in this test shall be designated for use with the power unit test specimen.

N 5.6.18.2 The power unit test specimen shall be inclined to a 15-degree angle in one of the four horizontal axial directions ±1 percent.

N **5.6.18.3** The power unit test specimen shall then power the tool through a single operational cycle to the tool's rated system input.

N **5.6.18.4** The rated system input that is achieved shall be recorded and evaluated to determine pass/fail.

N **5.6.18.5** The power unit test specimen shall then be inclined to a 15-degree angle in the second, third, and fourth horizontal axial directions.

N **5.6.18.6** The power unit test specimen shall then power the tool to the tool's rated system input through an additional single operational cycle for each additional 15-degree horizontal axial direction.

N **5.6.18.7** The rated system input that is achieved in each of the additional 15-degree horizontal axial directions shall be recorded and evaluated to determine pass/fail.

N **5.6.19 Power Unit Pressure Test.**

N **5.6.19.1** Power unit test specimens shall be tested on a level surface, and the system input shall be monitored by a gauge.

N **5.6.19.2 Operation.**

N **5.6.19.2.1** Power unit test specimens shall be operated at the rated system input designated for the specific power unit.

N **5.6.19.2.2** The rated system input shall be maintained for 1 minute.

N **5.6.19.3** During the 1-minute test specified in 5.6.19.2 and 5.6.19.2.1, the gauge shall be observed for any fluctuation to determine pass/fail.

N **5.6.19.4** Pressure fluctuation during the 1-minute test, if any, shall not be more than ±5 percent of the rated system input.

N **5.6.20 Power Unit Pressure Relief and Automatic Limiting Device Test.**

N **5.6.20.1** The output safety pressure relief valve or automatic limiting device of the power unit test specimen shall be set at the rated system input.

N **5.6.20.2 Testing.**

N **5.6.20.2.1** Power unit test specimens shall be tested on a level surface.

N **5.6.20.2.2** The system input shall be monitored by a gauge.

N **5.6.20.3 Input Level.**

N **5.6.20.3.1** The system input of the power unit test specimen shall be raised until the pressure relief or automatic shutoff device operates.

N **5.6.20.3.2** This test cycle shall be repeated for a total of 10 cycles.

N **5.6.20.4** The system input at which the pressure relief or automatic shutoff device operates shall be recorded for each of the 10 test cycles.

N **5.6.20.5** The recorded system input at which the pressure relief or automatic shutoff device operates shall be evaluated to determine pass/fail.

N **5.6.21 Power Unit Dump Valve Test.**

N **5.6.21.1** The dump valve of the power unit test specimen shall be tested at the maximum operating flow of the prime mover.

N **5.6.21.2 Supply Hose.**

N **5.6.21.2.1** Power unit test specimens shall be tested on a level surface with the supply hose connected to a tool that is designated for use with the power unit test specimen.

N **5.6.21.2.2** The supply hose shall then be pressurized.

N **5.6.21.3 Dumping.**

N **5.6.21.3.1** While the dump valve of the power unit test specimen is activated (i.e., open), the hose to the tool shall be disconnected.

N **5.6.21.3.2** The system then shall be repressurized and dumped again.

N **5.6.21.4 Reconnection.**

N **5.6.21.4.1** The hose shall then be reconnected to the tool.

N **5.6.21.4.2** The reconnection shall be possible without causing pressurization in the couplers or causing other related problems.

N **5.6.21.5** The disconnection and reconnection of the hose shall be evaluated to determine pass/fail.

N **5.6.21.6** The tool shall operate normally after the hose has been reconnected.

N **5.6.22 Power Unit Endurance Test.**

N **5.6.22.1 Testing.**

N **5.6.22.1.1** Power unit test specimens shall be tested on a level surface.

N **5.6.22.1.2** The system input shall be monitored by a gauge.

N **5.6.22.2** The power unit test specimen shall generate the rated system input and be held at the rated system input for 20 seconds.

N **5.6.22.3** The power unit shall then be relieved of the rated system input for 20 seconds.

N **5.6.22.4** The duration of the test shall comprise one hundred 20-second rated system input "held"/20-second rated system input "relieved" cycles.

N **5.6.22.5** A pause shall be permitted as required for refilling the fuel tank or changing replaceable battery packs.

N **5.6.22.6** Cooling of the hydraulic fluid, electric motor, and electric switches shall be permitted during the test.

N **5.6.22.7** The power unit test specimen shall be observed during and immediately after completion of the test to check for leaks or malfunction to determine pass/fail.

N **5.6.23 Directional Valve Endurance Test.**

N **5.6.23.1** The directional valve(s) of the power unit test specimen's hydraulic pump shall be subjected to a continual 5000-cycle endurance test during which fluid must be circulating through a connected tool, so as to cause the fluid to circulate through the hydraulic lines connecting it to the power unit.

N 5.6.23.1.1 A cycle for this test shall be defined as the activation of the directional valve(s) to its hard stop in each direction, and then returning the directional valve(s) to its neutral position.

N 5.6.23.1.2 It shall not be necessary to subject the directional valves to the rated system input pressure during the 5000 cycles.

N 5.6.23.2 Following the 5000 test cycles, the directional valve(s) shall be pressurized to 100 percent of the rated system input.

N 5.6.23.3 The directional valve(s) shall be observed for operation and leakage to determine pass/fail.

N 5.6.24 Remote Valve Block Endurance Test.

N 5.6.24.1 Remote valve block test specimens shall be subjected to a continual 5000-cycle endurance test during which fluid must be circulating through a connected tool, so as to cause the fluid to circulate through the hydraulic lines connecting it to the power unit.

N 5.6.24.1.1 A cycle for this test shall be defined as the activation of the directional valve(s) to its hard stop in each direction, and then returning the directional valve(s) to its neutral position.

N 5.6.24.1.2 It shall not be necessary to subject the remote valve block to reach the rated system input pressure during the 5000 system.

N 5.6.24.2 Following the 5000 test cycles, the remote valve blocks shall be pressurized to 100 percent of the rated system input.

N 5.6.24.3 The remote valve blocks shall be observed for leakage to determine pass/fail.

N 5.6.25 Hose Reel Endurance Test.

N 5.6.25.1 Cycles.

N 5.6.25.1.1 Hose reel test specimens shall be subjected to a 5000-cycle endurance test.

N 5.6.25.1.2 One cycle shall consist of one revolution in each direction.

N 5.6.25.2 After the 5000 test cycles, the rotary seal on the hose reel test specimen shall be pressurized to 100 percent of the maximum rated inlet pressure.

N 5.6.25.3 The rotary seal shall be observed for leakage to determine pass/fail.

N 5.6.26 Hose Assembly Proof Pressure Test.

N 5.6.26.1 The hose assembly shall be hydrostatic tested to 150 percent of the rated system input.

N 5.6.26.2 Duration.

N 5.6.26.2.1 The test pressure shall be maintained for 1 minute, +5 seconds/−0 seconds, and then released.

N 5.6.26.2.2 This procedure shall be performed twice in a 5-minute period.

N 5.6.26.3 The hose assembly shall be observed during and after the pressurization to determine pass/fail.

Δ Chapter 6 Lifting Bags

N 6.1 Administration.

N 6.1.1 Scope.

N 6.1.1.1 This chapter shall specify the minimum requirements for the design, performance, testing, and certification of air lifting bags and components.

N 6.1.1.2 Safety and Health.

N 6.1.1.2.1 This chapter shall not be construed as addressing all of the safety concerns, if any, associated with its use.

N 6.1.1.2.2 It shall be the responsibility of the persons and organizations that use this standard to establish safety and health practices and determine the applicability of regulatory limitations prior to use of this standard.

N 6.1.1.3 Nothing herein shall restrict any jurisdiction from specifying lifting bags and components that exceed the minimum requirements of this standard.

N 6.1.1.4 Nothing herein shall restrict any manufacturer from producing lifting bags and components that exceed the minimum requirements of this standard.

N 6.1.2 Purpose.

N 6.1.2.1 The purpose of this chapter shall be to establish minimum performance requirements for lifting bags and components that are utilized by emergency services personnel to facilitate the extrication of victims from entrapment.

N 6.1.2.2 Controlled laboratory environmental and physical tests are used to determine compliance with the performance requirements of this standard only; however, such tests shall not be deemed as establishing the performance levels of lifting bags and components for all situations.

N 6.1.2.3 This chapter is not intended to serve as a detailed manufacturing or purchase specification but shall be permitted to be referenced in purchase specifications as minimum acceptable requirements.

N 6.1.3 Application.

N 6.1.3.1 This chapter shall apply to the design, manufacturing, and certification of manufactured lifting bags and components.

N 6.1.3.2 The requirements of this chapter shall not apply to accessories that might be attached to lifting bags or components.

N 6.2 Product Labeling and Information.

N 6.2.1 Lifting Bags.

N 6.2.1.1 Each lifting bag shall have a product label permanently attached.

N 6.2.1.2 Each product label shall have the third-party certification organization's label, symbol, or identifying mark and at least the following compliance statement printed on the product label:

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N 6.2.1.3 The following information also shall be printed on the product label following the compliance statement specified in 6.2.1.2:

(1) Manufacturer's name and/or identification mark
(2) Product identification number, lot number, or serial number
(3) Month and year of manufacture (not coded)
(4) Month and year of expiration, which should be no greater than 15 years after date of manufacture
(5) Model name, number, or design
(6) Lifting capacity (applicable units)
(7) Maximum working height/stroke (cm/in.)
(8) Allowable pressure (bar/psi)

N **6.2.1.4** More than one label piece shall be permitted to carry all statements and information required of the product label.

N **6.2.1.5** The legibility of the items in 6.2.1.3(5) through 6.2.1.3(7) shall comply with 6.4.2.4.

N **6.2.2 Control Devices.** Control devices shall be marked with the manufacturer's name, manufacturer's model, all directions for operation, and maximum inlet pressure.

N **6.2.3 Manual Pumps.** Manual pumps shall be marked with the manufacturer's name or identification mark, or both, and the manufacturer's model number.

N **6.3 User Information.**

N **6.3.1** The lifting bag manufacturer shall provide a user manual with each lifting bag and component set, as described in 6.4.1.1.

N **6.3.2** The user manual shall be permitted to be in the form of printed, audiovisual, or web-based material, or any combination thereof.

N **6.3.3** Symbols and other pictorial graphic representations shall be permitted to be used to supplement worded statements on the product labels where those symbols and pictorial graphic representations are explained in the user information.

N **6.3.4** The manual(s) shall provide, at a minimum, the following information:

(1) Manufacturer's name and address
(2) Source for service and technical information
(3) How or where parts can be obtained
(4) Setup procedures
(5) Operating instructions
(6) Safety considerations
(7) Limitations of use
(8) Inspection procedures
(9) Recommended maintenance procedures
(10) Troubleshooting guide
(11) Manufacturer's warranty
(12) Special requirements or data required by this standard
(13) Storage procedures

N **6.3.5** The lifting bag manufacturer shall specify in the manual the length, width, and height dimensions of all lifting bags and components to establish the minimum storage dimensions.

N **6.4 Design Requirements.**

N **6.4.1 Lifting Bag System.**

N **6.4.1.1** A lifting bag system shall include the following components:

(1) Hose or hose assemblies, or both
(2) Regulator
(3) Control device for each lifting bag
(4) Pressure indicator for each lifting bag
(5) Safety valve for each lifting bag
(6) Lifting bag(s)

N **6.4.1.2** Components of a lifting bag system shall be designed only to fit mating components that are intended for use with the same allowable pressure.

N **6.4.1.3** Components of a lifting bag system shall be capable of being operated within the ambient temperature range of –20°C to +55°C (–4°F to +131°F).

N **6.4.1.4** The lifting bag system shall be designed to limit the speed of descent to no more than 25 mm/sec (1 in./sec) when the lifting bag is supporting a load at allowable pressure.

N **6.4.2 Lifting Bags.**

N **6.4.2.1** Each lifting bag type shall not show any loss of integrity or other structural failure when subjected to a pressure defined in Table 6.4.2.1.

N **6.4.2.2** The external or pressure containing material used in the construction of lifting bags shall resist penetration as specified in 6.5.14.

N **6.4.2.3** The connector incorporated into the lifting bag shall withstand an axial pulling force as specified in 6.5.16.

N **6.4.2.4 Legibility.**

N **6.4.2.4.1** Lifting bag product labels shall be tested for legibility as specified in 6.6.17.

N **6.4.2.4.2** Lifting bag product labels shall be able to be read by the unaided eye.

N **6.4.3 Hose Assemblies and Couplings.**

N **6.4.3.1** Hose assemblies shall have a minimum safety factor against burst of 400 percent of rated hose pressure.

N **6.4.3.2** Quick-connect couplers shall require at least two separate manual actions to disconnect.

N **6.4.3.3 Rating.**

N **6.4.3.3.1** All couplers and quick-connect couplers shall be rated for at least the rated system input.

N **6.4.3.3.2** All couplers and quick-connect couplers shall have a minimum safety factor of 400 percent of rated hose pressure.

N **6.4.3.4** All couplers and quick-connect couplers shall be able to be connected and disconnected while wearing gloves that are certified as compliant with the glove requirements of NFPA 1971.

N **Table 6.4.2.1 Test Pressure**

Allowable Pressure AP (in bar)	Pressure Volume (in bar liters)	Type Test Pressure	Individual or Production Test Pressure
1 bar or less	1500 or less	3 × AP	1.5 × AP
1 bar or less	Greater than 1500	4 × AP	1.5 × AP
Greater than 1 bar	1500 or less	4 × AP	1.5 × AP
Greater than 1 bar	Greater than 1500	4 × AP	1.5 × AP

N **6.4.3.5** Hose, fittings, and quick-connect couplings shall withstand an axial pulling force of at least 1000 N (225 lbf) when at atmospheric pressure and allowable pressure.

N **6.4.4 Control Devices.**

N **6.4.4.1** The control device shall permit the speed of inflation and deflation of the lifting bag to be gradually and progressively varied under the operator's control.

N **6.4.4.2** The control device shall be marked or labelled to indicate all positions of buttons or levers and how each position moves the lifting bag.

N **6.4.4.3** When a manual actuator is moved from any position of actuation to a neutral position, the flow of compressed air shall cease within less than 1.0 seconds.

N **6.4.4.4** When a manual actuator is released, it shall automatically return to the neutral position within less than 1.0 seconds.

N **6.4.4.5** Where a system includes two or more control devices connected to the same inlet, the operation of one manual actuator shall only inflate or deflate the lifting bag to which it is connected, regardless of the position of other manual actuators.

N **6.4.4.6** Operation of one or more control devices in the direction of inflation shall not lead to the deflation of any bag when any of the following happen:

(1) Supply connection to the control device is disconnected.
(2) Supply of compressed air is exhausted or is at pressures less than the pressure in the lifting bag.
(3) There is a sudden hose break of the supply hose to the control device.

N **6.4.4.7** Where a control device is provided with more than one inlet connection for energizing sources, it shall not be possible for the compressed air from one connection to pass out of another inlet, whether or not a hose is connected to the other inlet.

N **6.4.4.8** Control devices shall withstand a pressure of two times allowable pressure without leakage.

N **6.4.4.9** Control devices shall be operated while wearing gloves that are certified as compliant with the glove requirements of NFPA 1971.

N **6.4.4.10** The allowable inlet pressure of a control device shall be marked on the control device at or near the inlet.

N **6.4.4.11** When a manual actuator on a control device is actuated in a direction of operation, the lifting bag shall operate only in the direction selected by the operator.

N **6.4.5 Pressure Indicators.**

N **6.4.5.1** A pressure indication displaying the pressure in the lifting bag shall be provided in a position at which it can be read by the operator while operating the control device.

N **6.4.5.2** Pressure indicators shall comply with EN 837-1, *Standard Bourdon Tube Pressure Gauges*; EN 837-2, *Pressure Gauges — Part 2: Selection and Installation Recommendations for Pressure Gauges*; EN 837-3, *Pressure Gauges — Diaphragm and Capsule Pressure Gauges — Dimensions, Metrology, Requirements and Testing*; or ASME/ANSI B40.100, *Pressure Gauges and Gauge Attachments*.

N **6.4.6 Safety Valves.**

N **6.4.6.1** Safety valves shall be provided with means to lock or seal all external adjustments in such a manner so as to prevent unauthorized adjustments of the safety valve.

N **6.4.6.2** The actuation of a safety valve shall be indicated to the operator by any means such as an audible or visual sign.

N **6.4.6.3** When the safety valve is fully operating and the supply of air to the control device is maintained constant at the allowable pressure specified for the inlet, the pressure in the lifting bag shall not exceed 1.2 times the allowable pressure for the bag.

N **6.4.7 Additional/Optional Components.** When a manufacturer provides additional load-bearing accessories for its lifting airbag system, the components shall meet or exceed the safety and capacity ratings of the lifting bags.

N **6.4.8 Regulators.** Regulators shall meet standard ISO 2503, *Gas welding equipment — Pressure regulators for gas cylinders used in welding, cutting and allied processes up to 300 bar*; or UL 252, *Standard for Safety Compressed Gas Regulators*.

N **6.5 Performance Requirements.**

N **6.5.1** The lifting bag system shall be tested for operating temperature range as specified in 6.6.1, and not show signs of failure or leakage.

N **6.5.2** Hose assemblies shall be tested for pulling force as specified in 6.6.2 and show no signs of leakage.

N **6.5.3** Hose assemblies shall be tested for proof pressure test as specified in 6.6.3 and show no signs of leakage.

N **6.5.4** Control devices shall be tested as specified in 6.6.4 to ensure the operation of the lifting bag coincides with the manual operation of the control device.

N **6.5.5** Control devices shall be tested as specified in 6.6.5 to ensure the flow of air stops within 1.0 second or less when the control device's manual operation is moved to the neutral position.

N **6.5.6** Control devices shall be tested as specified in 6.6.6 to ensure when the manual actuator of the control device is released it will return to the neutral position within 1.0 second or less.

N **6.5.7** Control devices shall be tested as specified in 6.6.7 to ensure when a system of two or more control devices connected to the same inlet(s) is present, the operation of one manual actuator only inflates or deflates the lifting bag to which it is connected, regardless of the position of the other manual actuators.

N **6.5.8** Control devices shall be tested as specified in 6.6.8 to ensure that the operation of one or more control devices in inflation mode does not lead to the deflation of any bag when the supply connection to the control device is disconnected, the supply of compressed air is no longer present or at a pressure less than the pressure in the lifting bag, or there is a sudden loss of compressed air due to a hose failure.

N **6.5.9** Control devices shall be tested as specified in 6.6.9 to ensure compressed air from one connection cannot pass out of another inlet, with or without a hose connected, when a control device is provided with more than one inlet connection.

N **6.5.10** Control devices shall be tested as specified in 6.6.10 to ensure that the device shows no signs of leakage at overpressure of two times the allowable pressure.

N **6.5.11** Safety valves shall be tested as specified in 6.6.11 to ensure their actuation results in either an audible or visual method of notifying the operator the valves have operated.

N **6.5.12** Safety valves shall be tested as specified in 6.6.12.

N **6.5.13** Lifting bags shall be tested as specified in 6.6.13 for overpressure.

N **6.5.14 Resistance Against Penetration Test.**

N **6.5.14.1** Lifting bags shall be tested as specified in 6.6.14 for resistance against penetration.

N **6.5.14.2** A manufacturer shall apply either of the following requirements, or both:

(1) The following requirements are applicable to samples of materials:
   (a) The material used in the construction of a lifting bag shall resist penetration as tested per 6.6.14.
   (b) Samples presented for testing shall be taken from standard production bags.
   (c) All materials forming the pressure-containing bag, including any additional layers forming the bearing or side wall surfaces, shall be tested.
   (d) Where the construction of the bag varies in material thickness, number of layers, or reinforcing fibers or wires, samples that are representative of all variations shall be tested.

(2) The following requirements are applicable to complete lifting bags:
   (a) The material used in the construction of the lifting bag shall resist penetration at the load-bearing surfaces and all other areas directly contacting the load while the lifting bag is inflated as per 6.6.14.
   (b) Where the construction of the upper and lower load-bearing surfaces of a bag differs, each surface shall achieve the required standard.

N **6.5.15** Lifting bags shall be tested as specified in 6.6.15 to ensure the speed of descent is not more than 25 mm/sec (1 in./sec) when the lifting bag is supporting a load at allowable pressure.

N **6.5.16** Lifting bags shall be tested as specified in 6.6.16 to ensure the connector incorporated into the lifting bag can withstand an axial pulling force of 1000 N (225 lbf) for 1 minute and show no signs of leakage.

N **6.5.17** Lifting bags shall be tested to ensure label legibility as specified in 6.6.17.

N **6.5.18** Lifting bags shall be tested as specified in 6.6.18 to ensure the lifting capacity of the bag.

N **6.6 Testing.**

N **6.6.1 Lifting Bag Operating Temperature Test.**

N **6.6.1.1 Temperature.**

N **6.6.1.1.1** The lifting bag, regulator, control device, and hose assembly shall be stored in a temperature-conditioning chamber of −20°C ± 2°C (−4°F ± 4°F) for a minimum of 5 hours.

N **6.6.1.1.2** The 5-hour storage time shall begin when the temperature-conditioning chamber has stabilized at −20 ± 2°C (−4°F ± 4°F).

N **6.6.1.2** The lifting bag, regulator, control device, and hose assembly shall be removed from the temperature-conditioning chamber after being subjected to at least 5 hours at the conditioning temperature.

N **6.6.1.2.1** Within 3 minutes after removal from the temperature-conditioning chamber, the devices shall be assembled, connected to the air source, and pressurized to the allowable pressure.

N **6.6.1.2.2** The system shall remain pressurized for 1 minute.

N **6.6.1.3** The lifting bag, regulator, control device, and hose assembly shall be observed for defects and leaks during the 1-minute pressurization.

N **6.6.1.4 Second Test.**

N **6.6.1.4.1** The same test specimens, with the lifting bag deflated, shall then be stored in a temperature-conditioning chamber of 55°C ± 2°C (131°F ± 4°F) for a minimum of 5 hours.

N **6.6.1.4.2** The 5-hour storage time shall begin when the temperature-conditioning chamber has stabilized at 55°C ± 2°C (131°F ± 4°F).

N **6.6.1.5** The lifting bag, regulator, control device, and hose assembly shall be removed from the temperature-conditioning chamber after being subjected to at least 5 hours at the conditioning temperature.

N **6.6.1.5.1** Within 3 minutes after removal from the temperature-conditioning chamber, the devices shall be assembled, connected to the air source, and pressurized to the allowable pressure.

N **6.6.1.5.2** The system shall remain pressurized for 1 minute.

N **6.6.1.6** The lifting bag, regulator, control device, and hose assembly shall be observed for defects and leaks during the 1-minute pressurization.

N **6.6.2 Hose Assembly Pulling Force Test.**

N **6.6.2.1** An axial pulling force of a minimum of 1000 N (225 lbf) shall be applied to the hose assembly for 1 minute with the hose having an internal pressure of atmospheric pressure.

N **6.6.2.2** The axial pulling force then shall be removed from the hose assembly.

N **6.6.2.3** The hose assembly then shall be pressurized to allowable pressure and observed for any sign of leakage.

N **6.6.2.4** Leakage of the hose assembly shall constitute failure.

N **6.6.2.5** The test shall be repeated with a hose assembly having an internal pressure of allowable pressure.

N **6.6.3 Hose Assembly Proof Pressure Test.**

N **6.6.3.1** A sample representative hose assembly shall be attached to an air or a water supply capable of supplying four times the operating pressure.

N **6.6.3.2** A pressure gauge shall be attached to the end of the hose assembly.

N **6.6.3.3** The hose assembly shall be pressurized to four times the allowable pressure.

N **6.6.3.4** Leakage of the hose assembly shall constitute failure.

N **6.6.4 Control Device Dedicated Operation Test.**

N **6.6.4.1** The control device(s) shall be assembled into a system and connected to a lifting bag.

N **6.6.4.2 Inflation.**

N **6.6.4.2.1** Each control device shall be operated in the inflate mode.

N **6.6.4.2.2** It shall be verified that lifting bags connected control devices are set to operate in the inflate direction.

N **6.6.4.3 Deflation.**

N **6.6.4.3.1** Each control device shall be operated in the deflate mode.

N **6.6.4.3.2** It shall be verified that lifting bags connected to control devices are set to operate in the deflate direction.

N **6.6.4.4** A control device that does not operate its associated lifting bag in each intended mode of operation shall constitute failure.

N **6.6.5 Control Device Neutral Position Flow of Air Test.**

N **6.6.5.1** The control device shall be assembled into the system with a lifting bag specimen.

N **6.6.5.2 Inflation.**

N **6.6.5.2.1** The bag shall be inflated.

N **6.6.5.2.2** During inflation, the manual actuator of the control device shall be released.

N **6.6.5.3 Neutral Position.**

N **6.6.5.3.1** Once the manual actuator returns to the neutral position air flow shall cease in 1.0 second or less.

N **6.6.5.3.2** Air flow continuing after 1.0 second shall constitute failure.

N **6.6.5.4** The test shall be repeated with the lifting bag being deflated.

N **6.6.6 Control Device Neutral Position Test.**

N **6.6.6.1** The control device shall be assembled into the system with a lifting bag specimen.

N **6.6.6.2 Inflation.**

N **6.6.6.2.1** The bag shall be inflated.

N **6.6.6.2.2** During inflation, the manual actuator of the control device shall be released.

N **6.6.6.3 Neutral Position.**

N **6.6.6.3.1** The manual actuator shall return to the neutral position in 1.0 second or less.

N **6.6.6.3.2** Not returning in 1.0 second or less shall constitute failure.

N **6.6.7 Control Device Dedicated Controller Test.**

N **6.6.7.1** Each control device shall be assembled into a system and connected to a separate lifting bag.

N **6.6.7.2 Inflation.**

N **6.6.7.2.1** Each control device shall be operated independently in the inflate mode.

N **6.6.7.2.2** It shall be verified that lifting bags connected to control devices are set to operate in the inflate direction.

N **6.6.7.3 Deflation.**

N **6.6.7.3.1** Each control device shall be operated independently in the deflate mode.

N **6.6.7.3.2** It shall be verified that lifting bags connected to control devices are set to operate in the deflate direction.

N **6.6.7.4** A control device that does not operate its associated lifting bag in the intended mode of operation shall constitute failure.

N **6.6.8 Control Device Nonaccidental Deflation Test.**

N **6.6.8.1** The control device(s) shall be connected to a hose assembly with a gauge attached.

N **6.6.8.2** The hose assembly shall be pressurized to the allowable pressure.

N **6.6.8.3** The inlet hose to the control device(s) shall be depressurized to atmospheric pressure.

N **6.6.8.4** The inlet hose to the control device shall be disconnected from the control device.

N **6.6.8.5** A minimum of a 0.5 m (1.5 ft) hose assembly with the noncontrol device end open to the atmosphere shall be connected to the control device's inlet while the actuators are held in the inflation position.

N **6.6.8.6** Any loss of pressure from the controller shall constitute failure.

N **6.6.9 Control Device Single Inlet Air Flow Test.**

N **6.6.9.1** For control devices with more than one inlet, a supply hose shall be connected to the inlet.

N **6.6.9.2** A hose open to atmosphere shall be connected to the each additional inlet.

N **6.6.9.3** The control device shall be pressurized to allowable pressure.

N **6.6.9.4** Air flowing from the open hose of any additional inlet shall constitute failure.

N **6.6.10 Control Device Overpressure Test.**

N **6.6.10.1** Safety devices shall be allowed to be overridden or removed from the control device.

N **6.6.10.2** Pressure indicators shall be allowed to be removed from the control device and their connections blocked off.

N **6.6.10.3** The control device shall be connected to an air supply capable of supplying twice the operating pressure.

N **6.6.10.4** A hose assembly with a pressure test gauge shall be attached to an outlet of the control device.

N **6.6.10.5** The control device shall be pressurized to twice the allowable pressure by pressurizing the outlet hose on the control device.

N **6.6.10.6** Leakage to the control device or leakage of the control device shall constitute failure.

N **6.6.11 Control Safety Valve Activation Notification Test.**

N **6.6.11.1** The control device shall be connected to an air supply capable of supplying twice the allowable pressure.

N **6.6.11.2** A hose assembly shall be attached to an outlet of the control device to which a pressure gauge is attached.

N **6.6.11.3** The control device shall be pressurized to the value at which the safety valve operates in inflate mode.

N **6.6.11.4 Notification.**

N **6.6.11.4.1** Once the safety valve actuates, an audible or visual notification shall be given.

N **6.6.11.4.2** Failure to produce an audible or visual indication shall constitute failure.

N **6.6.12 Control Safety Valve Test.**

N **6.6.12.1** A hose assembly, with a connected pressure gauge, shall be connected to the outlet side of the control device.

N **6.6.12.2** A minimum test pressure of 125 percent of the allowable pressure specified for the control device shall be applied to the inlet of the control device.

N **6.6.12.3** The actuator shall be activated with respect to the outlet with the hose assembly and held in the open position to cause the safety valve to activate.

N **6.6.12.4** The maximum pressure of the pressure gauge on the outlet side shall be recorded.

N **6.6.12.5** The test for each control device outlet shall be repeated.

N **6.6.12.6** The pressure in the outlet hose exceeding 120 percent of allowable pressure or the safety valve not resetting itself shall constitute failure.

N **6.6.13 Lifting Bag Overpressure Test.**

N **6.6.13.1** For the lifting bag overpressure test, the lifting bag shall be permitted to be restrained at the maximum lifting bag height or unrestrained as decided by the manufacturer based on the type of bag where low pressure [<1 bar (<14.5 psi)] constitutes restrained, and high pressure [>1 bar (>14.5 psi)] constitutes unrestrained.

N **6.6.13.2** If the lifting bag is to be tested restrained, the restraining apparatus shall be set to the maximum lifting height of the bag.

N **6.6.13.3** Any integral safety or relief valves in the bag shall be blocked off.

N **6.6.13.4** The lifting bag shall be pressurized to the required test pressure in 6.4.2.1 while measuring the pressure using a pressure gauge or pressure transducer with a digital readout.

N **6.6.13.5** The test pressure shall be applied for a minimum of 15 seconds.

N **6.6.13.6** Any leakage or visual structural damage of the lifting bag failure shall constitute failure of the test.

N **6.6.14 Lifting Bag Penetration Test.**

N **6.6.14.1** The requirements in 6.6.14.1.1 through 6.6.14.1.13 shall be applicable to samples of materials *(see Figure 6.6.14.1)*.

N **6.6.14.1.1** The material used in the construction of a lifting bag shall resist penetration.

N **6.6.14.1.2** Samples presented for testing shall be taken from standard production bags.

N **6.6.14.1.3** All materials forming the lifting bag, including any additional layers forming the bearing or side wall surfaces, shall be tested.

N **6.6.14.1.4** Where the construction of the bag varies in material thickness, number of layers, reinforcing fibers, or wires, samples representative of all variations shall be tested.

N **6.6.14.1.5** The samples of the finished materials or lifting bags to be tested shall be no more than 90 days old from the date of manufacture.

N **6.6.14.1.5.1** The samples or lifting bags shall be conditioned at 21°C, ± 2°C (70°F, ± 4°F) for a minimum of 3 hours prior to the tests.

N **6.6.14.1.5.2** A new pin shall be used for each test.

N **6.6.14.1.5.3** The sample shall be clamped to the test frame and sealed to the top of the cylinder *(see Figure 6.6.14.1.5.3)*.

N **6.6.14.1.5.4** An inlet/exhaust pipe shall be fitted with a valve and pressure gauge to measure the internal pressure of the cylinder.

N **6.6.14.1.6** The steel test pin shall be a minimum of 20 mm (0.79 in.) long with a diameter of 6 mm (0.24 in.) and the end having a radius of not more than 0.1 mm (0.004 in.) extending far enough below its securing device to ensure that only the pin comes into contact with the sample during the test *(see Figure 6.6.14.1.6)*.

N **6.6.14.1.7** The pin shall be positioned centrally over the cylinder *(see Figure 6.6.14.1.7)*.

N **6.6.14.1.8** The sample shall be secured over the cylinder ensuring that the thinnest section of the material is below the pin.

N **6.6.14.1.9 Pressurization.**

N **6.6.14.1.9.1** The cylinder shall be pressurized to the allowable pressure for the bag type for which the sample is designated.

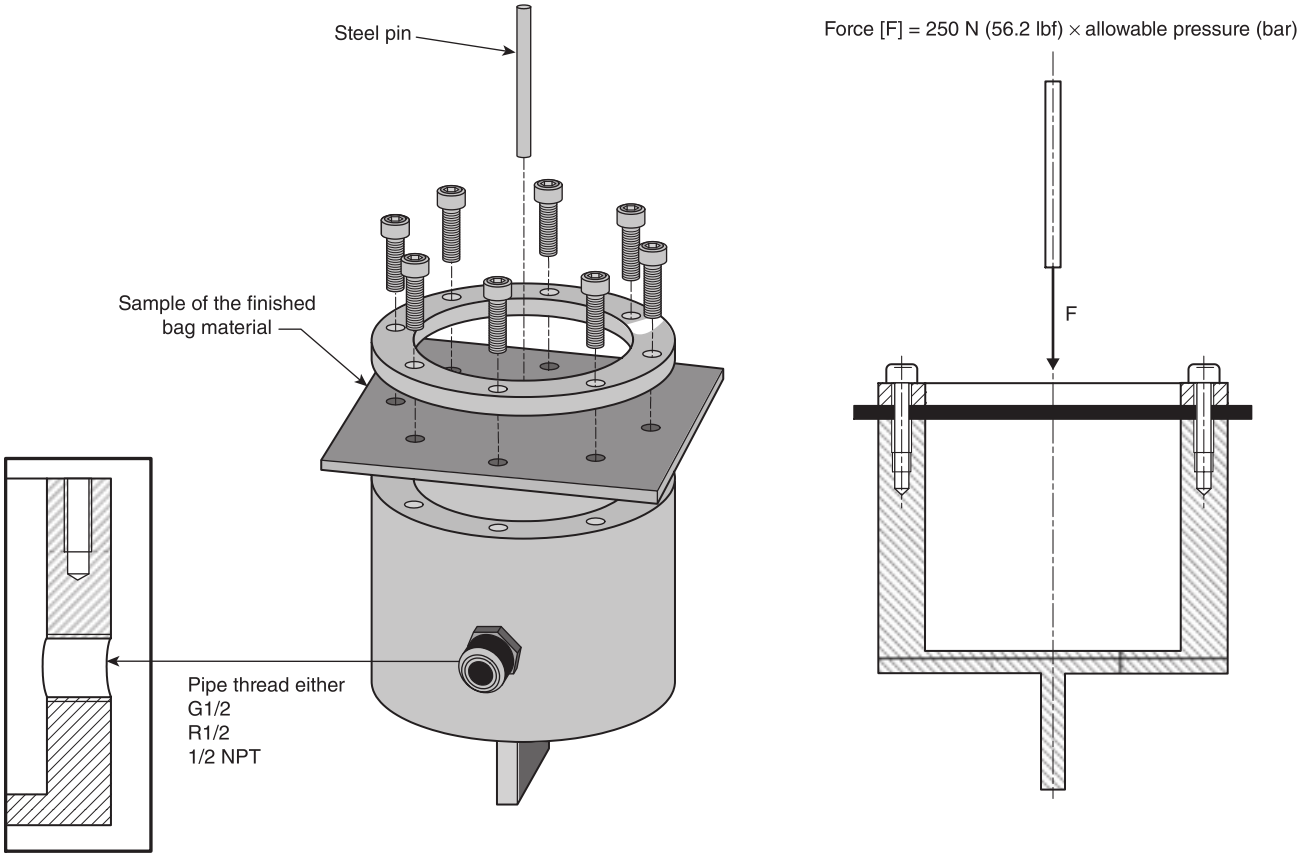
N **6.6.14.1.9.2** The flange seal shall be checked for leaks.

N **6.6.14.1.10 Pressure Release.**

N **6.6.14.1.10.1** The pressure shall be released.

N **6.6.14.1.10.2** The cylinder shall be vented to atmosphere to ensure there is no increase in pressure during the next step.

N **6.6.14.1.11** The pin shall be lowered at a speed of 100 mm/min (3.94 in./min), at a force of 250 N (56.2 lbf) × AP (allowable pressure in units bar) but not less than 1000 N (225 lbf).



N FIGURE 6.6.14.1 Lifting Bag Penetration Overview.

N 6.6.14.1.12 Repressurization.

N 6.6.14.1.12.1 The pin shall be withdrawn.

N 6.6.14.1.12.2 The cylinder shall be pressurized as in 6.6.14.1.9 and inspected for leakage.

N 6.6.14.1.13 Leakage through the material in 6.6.14.1.12.1 shall constitute failure.

N 6.6.14.2 The requirements in 6.6.14.1.1 through 6.6.14.1.13 shall be applicable to complete lifting bags.

N 6.6.14.2.1 The material used in the construction of the lifting bag shall resist penetration at the load-bearing surfaces and all other areas directly contacting the load while the lifting bag is inflated.

N 6.6.14.2.2 Where the construction of the upper and lower load-bearing surfaces of a bag differ, each surface shall achieve the required standard.

N 6.6.14.2.3 The load-bearing surface area of the lifting bag and all other areas directly in contact with the load shall be determined when the lifting bag is inflated to a height at least 20 mm (0.79 in.) greater than the insertion height, and a minimum of four test positions be selected for penetration where a pin will hit the middle of such an area, including any sidewall material, which could contact a load at this height.

N 6.6.14.2.4 Pins shall be steel with a diameter of 6 mm (0.24 in.) cut at 90 degrees to their length to protrude at least 20 mm (0.79 in.) below the plate and fixed to withstand a pushing force of 3000 N (674 lbf).

N 6.6.14.2.5 The area of the restraining plates of the test rig shall be greater than the surface area of the lifting bag at insertion height.

N 6.6.14.2.6 Pin Installation.

N 6.6.14.2.6.1 The pin shall be installed in the first selected position.

N 6.6.14.2.6.2 The distance between the plates of the test rig shall be set to 25 mm (1.0 in.) greater than the insert height for the bag.

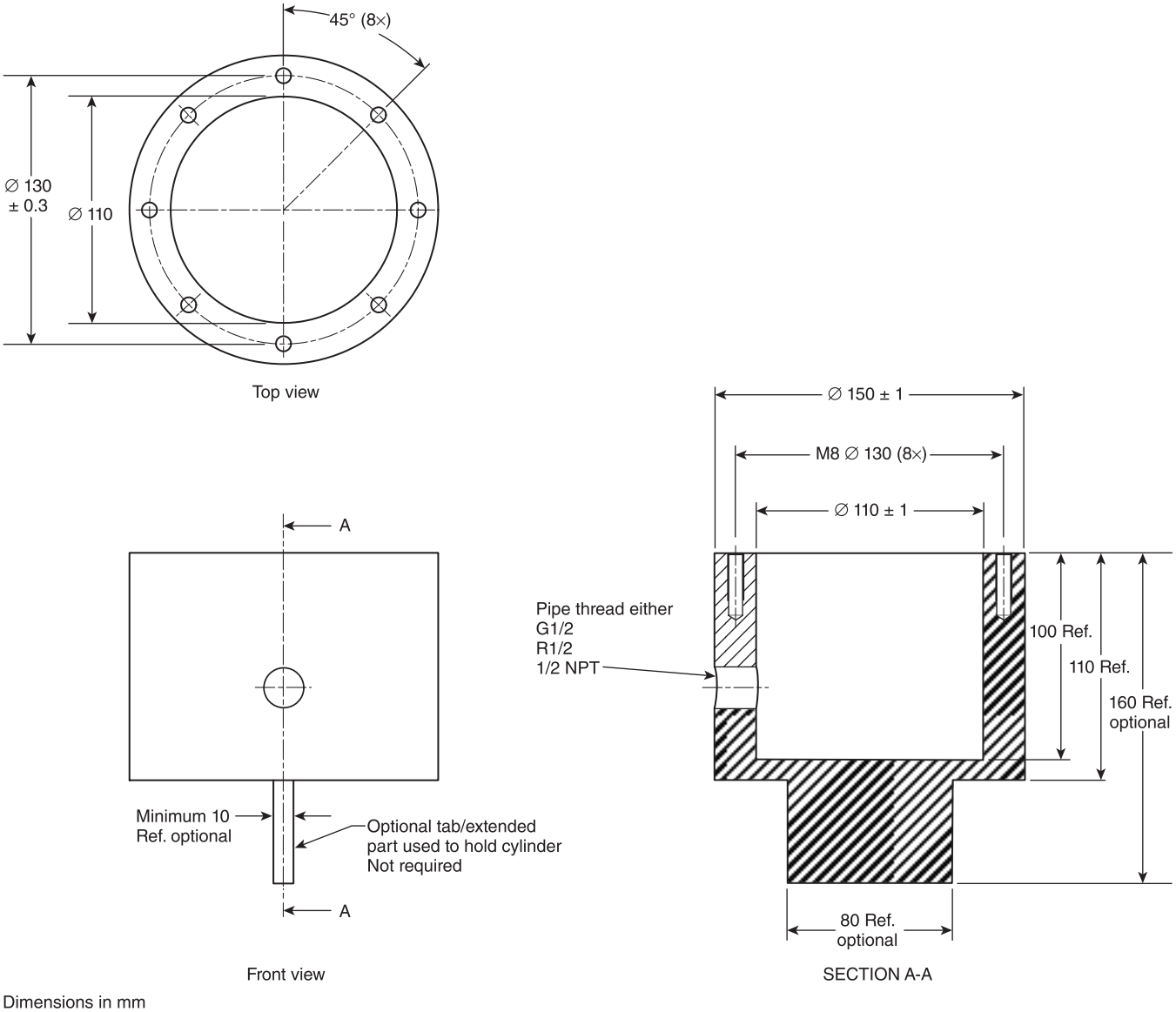
N 6.6.14.2.6.3 The bag shall be installed.

N 6.6.14.2.7 The bag shall be inflated to allowable pressure and that pressure shall be maintained for 10 seconds.

N 6.6.14.2.8 The procedures in 6.6.14.2.6.1 and 6.6.14.2.7 shall be repeated for the other selected position.

N 6.6.14.2.9 The lifting bag shall be removed from the test rig, inflated to allowable pressure for 1 minute, and observed for leakage.

N 6.6.14.2.10 If there is a variation in the construction of the upper and lower surfaces of the lifting bag, 6.6.14.2.3 through 6.6.14.2.9 shall be repeated with the bag inverted.



Dimensions in mm
For U.S. units, 25.4 mm = 1 in.

N FIGURE 6.6.14.1.5.3 Lifting Bag Penetrator Test Cylinder.

N 6.6.14.2.11 Failure to achieve the pressure in 6.6.14.2.9 shall constitute failure.

N 6.6.15 Lifting Bag Descent Speed Limit Test.

N 6.6.15.1 The lifting bag shall be inflated to the maximum lifting height while under a load achieving the allowable pressure.

N 6.6.15.2 A sudden hose rupture shall be simulated by completely severing the inflation hose to the bag.

N 6.6.15.3 The rate of descent of the bag shall be measured.

N 6.6.15.4 The bag descending at a rate of more than 25 mm/sec (1 in./sec) shall constitute failure.

N 6.6.16 Lifting Bag Connector Pulling Test.

N 6.6.16.1 The lifting bag or section of bag shall be secured between two plates.

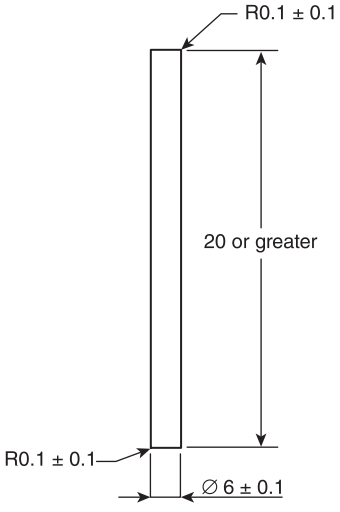
N 6.6.16.2 The connector, associated flanges, and any reinforcing fabric shall protrude from the plates by at least 50 mm (2.0 in.).

N 6.6.16.3 The test section or bag shall be inflated to the allowable pressure of the designated bag to test air integrity and then deflated.

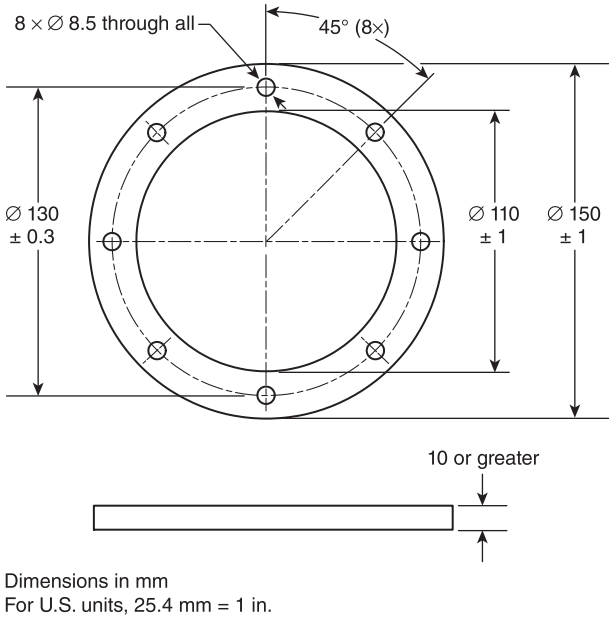
N 6.6.16.4 A coupling shall be connected to the connector and an axial pulling force of 1000 N (225 lbf) shall be applied for 1 minute.

N 6.6.16.5 The test section or bag shall be inflated to the allowable pressure, maintained for 1 minute, and observed for leakage.

N 6.6.16.6 Any leakage of the bag or test section of bag shall constitute failure.



N FIGURE 6.6.14.1.6 Penetration Test Steel Pin.



N FIGURE 6.6.14.1.7 Lifting Bag Penetration Test Top Ring.

N 6.6.17 Label Legibility Test.

N 6.6.17.1 For bags with a surface area less than 1452 sq. cm. (225 in.^{2}), label specimens shall be examined for legibility to the unaided eye by a person with 20/20 vision or vision corrected to 20/20, at a nominal distance of 457 mm (18 in.) in a well-illuminated area.

N 6.6.17.2 For bags with a surface area of 1452 sq. cm (225 in.^{2}) or greater, label specimens shall be examined for legibility to the unaided eye by a person with 20/20 vision, or vision corrected to 20/20, at a nominal distance of 914 mm (36 in.) in a well-illuminated area.

N 6.6.17.3 Samples shall be whole lifting bags with labels attached.

N 6.6.18 Lifting Bag Capacity Test.

N 6.6.18.1 For this test, the allowable pressure shall be used.

N 6.6.18.2 The lifting bag shall be placed in a fixture and the force measured at the insertion height plus 25 mm (1 in.).

N 6.6.18.3 This measured force shall be printed on the bag.

N 6.6.18.4 The lifting bag shall be inflated at 25 mm (1 in.) increments and the force be measured at each (1 in.) increment until full inflation height and be included in the user manual.

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Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.2.4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

N A.3.3.12 Product Label. This product label is not the third-party certification organization's label, symbol, or identifying mark; however, the third-party certification organization's label, symbol, or identifying mark is attached to it or part of it. *(See also 3.2.3, Labeled.)*

N **A.3.4.9 Powered Rescue Tool Components.** The individual parts that are assembled in a rescue tool or component thereof, such as seals, screws, valves, and switches, are not themselves considered as components for the purposes of this standard.

A.4.1.7 The National Fire Protection Association (NFPA), from time to time, has received complaints that certain products might be carrying labels falsely identifying them as compliant with an NFPA standard.

NFPA advises those purchasing a rescue tool to be aware of the following:

For a rescue tool to meet the requirements of NFPA 1936, it must be certified by an independent, third-party certification organization. In addition, the product must carry the label, symbol, or other identifying mark of that third-party certification organization.

Any rescue tool system or rescue tool that does not bear the mark of an independent, third-party certification organization is NOT COMPLIANT with NFPA 1936 even if the product label states that the item is compliant.

For further information about certification and product labeling, refer to Chapters 4 and 5 of this standard. Also, see the definitions for *certification, labeled*, and *listed* in Chapter 3.

Third-party certification is an important means of ensuring the quality of rescue tool systems or rescue tools. To be certain that an item is properly certified, labeled, and listed, NFPA recommends that prospective purchasers require appropriate evidence of certification for the specific product and model from the manufacturer before purchasing. Prospective purchasers should also contact the third-party certification organization and request copies of the third-party certification organization's list of certified products to the appropriate NFPA standard. This listing is a requirement of third-party certification by this standard and is a service performed by the third-party certification organization.

A.4.2.1 The third-party certification organization should have a sufficient breadth of interest and activity so that the loss or award of a specific business contract would not be a determining factor in the financial well-being of the agency.

A.4.2.5 The contractual provisions covering certification programs should contain clauses advising the manufacturer that if requirements change, the product should be brought into compliance with the new requirements by a stated effective date through a compliance review program involving all currently listed products.

Without these clauses, certifiers would not be able to move quickly to protect their names, marks, or reputations. A product safety certification program would be deficient without these contractual provisions and the administrative means to back them up.

A.4.2.6 Investigative procedures are important elements of an effective and meaningful product safety certification program. A preliminary review should be carried out on products submitted to the agency before any major testing is undertaken.

A.4.2.9 The third-party certification organization's follow-up inspections should include, in most instances, the witnessing of production tests. In the case of certain products, the third-party certification organization inspectors should select samples from the production line and submit them to the third-party certification organization for countercheck testing. In the case of other products, it can be beneficial to purchase samples in the open market for test purposes.

A.4.4.1 For further information and guidance on recall programs, see 21 CFR 7, Subpart C.

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N **A.5.4.1.8** Dust caps can be provided to keep dirt out of the couplings.

N **A.5.4.4.4.2.1** For example, if the cutter succeeds in cutting 12 pieces each of 19 mm (¾ in.) diameter round bar (performance Level 4 of material Category A), 9.5 mm × 76 mm (⅜ in. × 3 in.) flat bar (performance Level 6 of material Category B), 51 mm (2 in.) diameter round pipe (performance Level 6 of material Category C), 38 mm × 305 mm (1½ in. × 12 in.) square tube (performance Level 5 of material Category D), and 38 mm × 9.5 mm (1½ in. × ⅜ in.) angle iron (performance Level 7 of material Category E), the cutter would receive a level rating expressed as A4/B6/C6/D5/E7.

N **A.5.4.5.3.2** For example, if the cutter succeeds in cutting 12 pieces each of 19 mm (¾ in.) diameter round bar (performance Level 4 of material Category A), 9.5 mm × 76 mm (⅜ in. × 3 in.) flat bar (performance Level 6 of material Category B), 51 mm (2 in.) diameter round pipe (performance Level 6 of material Category C), 38 mm × 305 mm (1½ in. × 12 in.) square tube (performance Level 5 of material Category D), and 38 mm × 9.5 mm (1½ in. × ⅜ in.) angle iron (performance Level 7 of material Category E), the cutter would receive a level rating expressed as A4/B6/C6/D5/E7.

N **A.5.4.6.4** The external mechanical loads that can significantly reduce hose life include excessive flexing, twisting, kinking, tensile or side loads, bend radius, and vibration. The manufacturer should consider the use of swivel-type fittings or adapters to ensure that the hose is not twisted during usage or storage.

N **A.5.5.3.4.2** The 60 qualified cuts are the minimum total where 12 cuts are made for a single numerical performance level in each of five material categories.

N **A.5.5.3.4.4** For example, if the cutter succeeds in cutting 12 pieces each of 19 mm (¾ in.) diameter round bar (performance Level 4 of material Category A), 9.5 mm × 76 mm (⅜ in. × 3 in.) flat bar (performance Level 6 of material Category B), 51 mm (2 in.) diameter round pipe (performance Level 6 of material Category C), 38 mm × 305 mm (1½ in. × 12 in.) square tube (performance Level 5 of material Category D), and 38 mm × 9.5 mm (1½ in. × ⅜ in.) angle iron (performance Level 7 of material Category E), the cutter would receive a level rating expressed as A4/B6/C6/D5/E7.

N **A.5.5.4.2.2** The 60 qualified cuts are the minimum total where 12 cuts are made for a single numerical performance level in each of five material categories.

N **A.5.5.4.2.4** For example, if the cutter succeeds in cutting 12 pieces each of 19 mm (¾ in.) diameter round bar (performance Level 4 of material Category A), 9.5 mm × 76 mm (⅜ in. × 3 in.) flat bar (performance Level 6 of material Category B), 51 mm (2 in.) diameter round pipe (performance Level 6 of material Category C), 38 mm × 305 mm (1½ in. × 12 in.) square tube (performance Level 5 of material Category D), and 38 mm × 9.5 mm (1½ in. × ⅜ in.) angle iron (performance Level 7 of material Category E), the cutter would receive a level rating expressed as A4/B6/C6/D5/E7.

N **A.5.6.15.1** The alloy shall be 4130 according to the detailed specifications contained in AMS 6371, *Steel, Mechanical Tubing, 0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130)*. The sample should be heat treated to a hardness of at least 32 on the Rockwell C scale. The physical dimensions and tolerances of the sample's profile should be verified to meet those published in ASTM A519/A519M, *Standard Specification for Seamless Carbon and Alloy Steel Mechanical Tubing*.

Annex B Informational References

B.1 Referenced Publications. The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

B.1.1 NFPA Publications. (Reserved)

B.1.2 Other Publications.

B.1.2.1 U.S. Government Publications. U.S. Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Title 21, Code of Federal Regulations, Part 7, Subpart C.

B.2 Informational References. (Reserved)

B.3 References for Extracts in Informational Sections. (Reserved)

Index

Sequence of Events for the Standards Development Process

Once the current edition is published, a Standard is opened for Public Input.

Step 1 – Input Stage

- Input accepted from the public or other committees for consideration to develop the First Draft
- Technical Committee holds First Draft Meeting to revise Standard (23 weeks); Technical Committee(s) with Correlating Committee (10 weeks)
- Technical Committee ballots on First Draft (12 weeks); Technical Committee(s) with Correlating Committee (11 weeks)
- Correlating Committee First Draft Meeting (9 weeks)
- Correlating Committee ballots on First Draft (5 weeks)
- First Draft Report posted on the document information page

Step 2 – Comment Stage

- Public Comments accepted on First Draft (10 weeks) following posting of First Draft Report
- If Standard does not receive Public Comments and the Technical Committee chooses not to hold a Second Draft meeting, the Standard becomes a Consent Standard and is sent directly to the Standards Council for issuance (see Step 4) or
- Technical Committee holds Second Draft Meeting (21 weeks); Technical Committee(s) with Correlating Committee (7 weeks)
- Technical Committee ballots on Second Draft (11 weeks); Technical Committee(s) with Correlating Committee (10 weeks)
- Correlating Committee Second Draft Meeting (9 weeks)
- Correlating Committee ballots on Second Draft (8 weeks)
- Second Draft Report posted on the document information page

Step 3 – NFPA Technical Meeting

- Notice of Intent to Make a Motion (NITMAM) accepted (5 weeks) following the posting of Second Draft Report
- NITMAMs are reviewed and valid motions are certified by the Motions Committee for presentation at the NFPA Technical Meeting
- NFPA membership meets each June at the NFPA Technical Meeting to act on Standards with "Certified Amending Motions" (certified NITMAMs)
- Committee(s) vote on any successful amendments to the Technical Committee Reports made by the NFPA membership at the NFPA Technical Meeting

Step 4 – Council Appeals and Issuance of Standard

- Notification of intent to file an appeal to the Standards Council on Technical Meeting action must be filed within 20 days of the NFPA Technical Meeting
- Standards Council decides, based on all evidence, whether to issue the standard or to take other action

Notes:

1. Time periods are approximate; refer to published schedules for actual dates.
2. Annual revision cycle documents with certified amending motions take approximately 101 weeks to complete.
3. Fall revision cycle documents receiving certified amending motions take approximately 141 weeks to complete.

Committee Membership Classifications[1,2,3,4]

The following classifications apply to Committee members and represent their principal interest in the activity of the Committee.

1. M *Manufacturer:* A representative of a maker or marketer of a product, assembly, or system, or portion thereof, that is affected by the standard.
2. U *User:* A representative of an entity that is subject to the provisions of the standard or that voluntarily uses the standard.
3. IM *Installer/Maintainer:* A representative of an entity that is in the business of installing or maintaining a product, assembly, or system affected by the standard.
4. L *Labor:* A labor representative or employee concerned with safety in the workplace.
5. RT *Applied Research/Testing Laboratory:* A representative of an independent testing laboratory or independent applied research organization that promulgates and/or enforces standards.
6. E *Enforcing Authority:* A representative of an agency or an organization that promulgates and/or enforces standards.
7. I *Insurance:* A representative of an insurance company, broker, agent, bureau, or inspection agency.
8. C *Consumer:* A person who is or represents the ultimate purchaser of a product, system, or service affected by the standard, but who is not included in (2).
9. SE *Special Expert:* A person not representing (1) through (8) and who has special expertise in the scope of the standard or portion thereof.

NOTE 1: "Standard" connotes code, standard, recommended practice, or guide.

NOTE 2: A representative includes an employee.

NOTE 3: While these classifications will be used by the Standards Council to achieve a balance for Technical Committees, the Standards Council may determine that new classifications of member or unique interests need representation in order to foster the best possible Committee deliberations on any project. In this connection, the Standards Council may make such appointments as it deems appropriate in the public interest, such as the classification of "Utilities" in the National Electrical Code Committee.

NOTE 4: Representatives of subsidiaries of any group are generally considered to have the same classification as the parent organization.

Submitting Public Input / Public Comment Through the Online Submission System

Following publication of the current edition of an NFPA standard, the development of the next edition begins and the standard is open for Public Input.

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- Choose the link "The next edition of this standard is now open for Public Input." You will be asked to sign in or create a free online account with NFPA before using this system.
- Follow the online instructions to submit your Public Input (see www.nfpa.org/publicinput for detailed instructions).
- Once a Public Input is saved or submitted in the system, it can be located on the "My Profile" page by selecting the "My Public Inputs/Comments/NITMAMs" section.

Submit a Public Comment

Once the First Draft Report becomes available there is a Public Comment period. Any objections or further related changes to the content of the First Draft must be submitted at the Comment Stage. To submit a Public Comment follow the same steps as previously explained for the submission of Public Input.

Other Resources Available on the Document Information Pages

Header: View document title and scope, access to our codes and standards or NFCSS subscription, and sign up to receive email alerts.

Research current and previous edition information.

Follow the committee's progress in the processing of a standard in its next revision cycle.

View current committee rosters or apply to a committee.

For members, officials, and AHJs to submit standards questions to NFPA staff. Our Technical Questions Service provides a convenient way to receive timely and consistent technical assistance when you need to know more about NFPA standards relevant to your work.

Provides links to available articles and research and statistical reports related to our standards.

Discover and purchase the latest products and training.

View related publications, training, and other resources available for purchase.

Information on the NFPA Standards Development Process

I. Applicable Regulations. The primary rules governing the processing of NFPA standards (codes, standards, recommended practices, and guides) are the NFPA *Regulations Governing the Development of NFPA Standards (Regs)*. Other applicable rules include NFPA *Bylaws*, NFPA *Technical Meeting Convention Rules*, NFPA *Guide for the Conduct of Participants in the NFPA Standards Development Process*, and the NFPA *Regulations Governing Petitions to the Board of Directors from Decisions of the Standards Council*. Most of these rules and regulations are contained in the *NFPA Standards Directory*. For copies of the *Directory*, contact Codes and Standards Administration at NFPA headquarters; all these documents are also available on the NFPA website at "www.nfpa.org/regs."

The following is general information on the NFPA process. All participants, however, should refer to the actual rules and regulations for a full understanding of this process and for the criteria that govern participation.

II. Technical Committee Report. The Technical Committee Report is defined as "the Report of the responsible Committee(s), in accordance with the Regulations, in preparation of a new or revised NFPA Standard." The Technical Committee Report is in two parts and consists of the First Draft Report and the Second Draft Report. (See *Regs* at Section 1.4.)

III. Step 1: First Draft Report. The First Draft Report is defined as "Part one of the Technical Committee Report, which documents the Input Stage." The First Draft Report consists of the First Draft, Public Input, Committee Input, Committee and Correlating Committee Statements, Correlating Notes, and Ballot Statements. (See *Regs* at 4.2.5.2 and Section 4.3.) Any objection to an action in the First Draft Report must be raised through the filing of an appropriate Comment for consideration in the Second Draft Report or the objection will be considered resolved. [See *Regs* at 4.3.1(b).]

IV. Step 2: Second Draft Report. The Second Draft Report is defined as "Part two of the Technical Committee Report, which documents the Comment Stage." The Second Draft Report consists of the Second Draft, Public Comments with corresponding Committee Actions and Committee Statements, Correlating Notes and their respective Committee Statements, Committee Comments, Correlating Revisions, and Ballot Statements. (See *Regs* at 4.2.5.2 and Section 4.4.) The First Draft Report and the Second Draft Report together constitute the Technical Committee Report. Any outstanding objection following the Second Draft Report must be raised through an appropriate Amending Motion at the NFPA Technical Meeting or the objection will be considered resolved. [See *Regs* at 4.4.1(b).]

V. Step 3a: Action at NFPA Technical Meeting. Following the publication of the Second Draft Report, there is a period during which those wishing to make proper Amending Motions on the Technical Committee Reports must signal their intention by submitting a Notice of Intent to Make a Motion (NITMAM). (See *Regs* at 4.5.2.) Standards that receive notice of proper Amending Motions (Certified Amending Motions) will be presented for action at the annual June NFPA Technical Meeting. At the meeting, the NFPA membership can consider and act on these Certified Amending Motions as well as Follow-up Amending Motions, that is, motions that become necessary as a result of a previous successful Amending Motion. (See 4.5.3.2 through 4.5.3.6 and Table 1, Columns 1-3 of *Regs* for a summary of the available Amending Motions and who may make them.) Any outstanding objection following action at an NFPA Technical Meeting (and any further Technical Committee consideration following successful Amending Motions, see *Regs* at 4.5.3.7 through 4.6.5) must be raised through an appeal to the Standards Council or it will be considered to be resolved.

VI. Step 3b: Documents Forwarded Directly to the Council. Where no NITMAM is received and certified in accordance with the *Technical Meeting Convention Rules*, the standard is forwarded directly to the Standards Council for action on issuance. Objections are deemed to be resolved for these documents. (See *Regs* at 4.5.2.5.)

VII. Step 4a: Council Appeals. Anyone can appeal to the Standards Council concerning procedural or substantive matters related to the development, content, or issuance of any document of the NFPA or on matters within the purview of the authority of the Council, as established by the *Bylaws* and as determined by the Board of Directors. Such appeals must be in written form and filed with the Secretary of the Standards Council (see *Regs* at Section 1.6). Time constraints for filing an appeal must be in accordance with 1.6.2 of the *Regs*. Objections are deemed to be resolved if not pursued at this level.

VIII. Step 4b: Document Issuance. The Standards Council is the issuer of all documents (see Article 8 of *Bylaws*). The Council acts on the issuance of a document presented for action at an NFPA Technical Meeting within 75 days from the date of the recommendation from the NFPA Technical Meeting, unless this period is extended by the Council (see *Regs* at 4.7.2). For documents forwarded directly to the Standards Council, the Council acts on the issuance of the document at its next scheduled meeting, or at such other meeting as the Council may determine (see *Regs* at 4.5.2.5 and 4.7.4).

IX. Petitions to the Board of Directors. The Standards Council has been delegated the responsibility for the administration of the codes and standards development process and the issuance of documents. However, where extraordinary circumstances requiring the intervention of the Board of Directors exist, the Board of Directors may take any action necessary to fulfill its obligations to preserve the integrity of the codes and standards development process and to protect the interests of the NFPA. The rules for petitioning the Board of Directors can be found in the *Regulations Governing Petitions to the Board of Directors from Decisions of the Standards Council* and in Section 1.7 of the *Regs*.

X. For More Information. The program for the NFPA Technical Meeting (as well as the NFPA website as information becomes available) should be consulted for the date on which each report scheduled for consideration at the meeting will be presented. To view the First Draft Report and Second Draft Report as well as information on NFPA rules and for up-to-date information on schedules and deadlines for processing NFPA documents, check the NFPA website (www.nfpa.org/docinfo) or contact NFPA Codes & Standards Administration at (617) 984-7246.

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